MARCONI
INSTRUMENTS

(1)

EB 995A/1
2 - 3/55

OPERATING AND MAINTENANCE

HANDBOOK

for

F.M./A.M. SIGNAL GENERATOR

TYPE TF 995A/1

MF MASTER
MA30916

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SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items:-

1. One: F.M./A.M. Signal Generator Type TF 995A/1 complete with attached mains lead, output cable and valves, etc. as under.

Valves:	Six:	Type EF95 Pentodes.
	Two:	Type 6AK6 Pentodes.
	One:	Type 6AU6 Pentode.
	One:	Type 12AT7 Double-Triode.
	One:	Type QS150/15 Voltage Stabilizer.
	One:	Type 5Z4G Full-Wave Rectifier.
	One:	Type EB91 Double-Diode.
Lamp:	One:	6.5-volt, 0.3-amp, M.E.S., Pilot Lamp.
Crystals:	One:	Type H.A. 333.3 kc/s Oscillator.
	One:	BTH Type CS2A Rectifier.

2. One: Terminating Unit Type TM 4308.

3. One: Attenuator Pad Type TM 4736.

4. One: Coaxial Free Plug, Belling Lee Type L734/P.

5. One: Telephone Jack Plug - tip, ring and sleeve - ST and C Type 4006.

6. One: Operating and Maintenance Handbook No. EB 995A/1.

1. DESCRIPTION

1.1. GENERAL

Signal Generator Type TF 995A/1 is a compact, a.c. mains operated, transportable instrument. It has a frequency range covering from 2 to 216 Mc/s in five bands and there are facilities for crystal standardization from 13.5 Mc/s upwards; its open-circuit output level is variable, in 1-dB steps, from a minimum of 0.1 μV to a maximum of 100 mV at 52 ohms and 200 mV at 75 ohms. The output may be c.w., frequency modulated, amplitude modulated, or simultaneously both frequency and amplitude modulated. The modulation, obtained either from an internal 1000-c/s oscillator or from an external source, is variable to maximum frequency deviations ranging from 25 to 600 kc/s for f.m., and to depths up to 50% for a.m.

1.2. DESIGN DETAILS

(a) R.F. Circuits. The r.f. oscillator itself is variable only over the fundamental frequency range of 4.5 to 9 Mc/s, the output bands of 13.5 to 27 Mc/s, 27 to 54 Mc/s, 54 to 108 Mc/s, and 108 to 216 Mc/s being obtained from a chain of four ganged harmonic multipliers of X3, X2, X2, and X2 respectively. Setting the frequency range switch to indicate which of the above four bands is required, determines which of the multipliers acts as output stage.

Output over the 2- to 13.5-Mc/s band is obtained by applying the 27- to 54-Mc/s output of the second multiplier to a single-valve circuit which combines the functions of a mixer and 30-Mc/s oscillator. The variable-frequency output from the second multiplier is thus heterodyned with a fixed 30-Mc/s signal and the output from the oscillator-mixer stage contains a difference-frequency component which is utilized - after filtering and amplification - to provide outputs between 2 and 13.5 Mc/s. The main tuning dial has five scales, all direct reading in output frequency; four of the scales are for the bands extending upwards from 13.5 Mc/s; the fifth scale is for the 2- to 13.5-Mc/s band. This fifth scale is calibrated directly in terms of the difference between 30 Mc/s and the output frequency of the second multiplier; since the scale extends from 2 to 13.5 Mc/s, it covers an arc which corresponds to the second multiplier being tuned from 32 to 43.5 Mc/s.

Whichever r.f. band is in use, the ultimate output is derived via two resistive 75-ohm ladder-network attenuators in cascade. The first attenuator has a range of 80 dB and is variable in 20-dB steps;

1.2. (Continued)

the second has a range of 20 dB and is variable in 2-dB steps. The input to the cascade is adjustable by means of a SET R.F. control and monitored by a meter having a SET R.F. mark and, respectively above and below this mark, plus and minus 1-dB marks to allow interpolation between the 2-dB steps of the second attenuator. The output from the second attenuator is applied to a coaxial cable which, at one end, is permanently attached to the Signal Generator; the direct open-circuit output obtainable from this cable is at a source impedance of 75 ohms and is variable between 2 μV and 200 mV. A plug-on terminating unit and a separate 20-dB attenuator pad are supplied with the instrument; with the terminating unit in use, outputs within the range 1 μV to 100 mV are obtainable at source impedances of both 52 and 75 ohms; with the attenuator pad interposed between the output cable and the terminating unit, outputs down to 0.1 μV are obtainable.

The built-in crystal calibrator - the crystal unit of which has a fundamental frequency of 333.3 kc/s - is coupled to the variable-frequency r.f. oscillator and provides fourteen checking points on each of the four upper r.f. bands covered by the Signal Generator. The h.t. supply to the calibrator is automatically switched on by inserting a telephone jack plug into the CRYSTAL CHECK socket on the front panel; the heterodyne beats at the checking points may then be heard in the head telephones or via the receiver under test. To facilitate tuning, a worm and wormwheel slow-motion drive is incorporated and the cursor of the tuning dial is adjustable so that it may be set to correspond exactly with the nearest crystal check point.

(b) Modulation System. Either external or internal a.f. modulation (f.m. or a.m.) may be applied, the internal source being a 1000-c/s valve oscillator. Frequency modulation is applied to the r.f. oscillator by a reactor valve fed from the a.f. source via a continuously variable potentiometer, cathode follower, and ganged attenuating system which maintains the deviation sensibly constant at all radio frequencies in every band. The normal deviation ranges on all carrier bands are 25 kc/s and 75 kc/s, but switching is provided which, ignoring the 2- to 13.5-Mc/s band, enables the deviation to be increased proportionally with increase in carrier frequency multiplication, the maximum deviation on the highest frequency band being 75 x 8 = 600 kc/s. On the 2- to 13.5-Mc/s band, the maximum deviation obtainable is 150 kc/s.

Amplitude modulation, to a continuously variable depth extending to 50% in the case of the internal 1000-c/s source, is applied to the highest-frequency harmonic multiplier which is operating for the

1.2. (Continued)

particular r.f. output band in use; this method helps to reduce the spurious frequency modulation often encountered when modulating an r.f. oscillator directly.

Simultaneous amplitude and frequency modulation, of use, for example, when investigating the performance of limiter stages in f.m. receivers, is obtained by setting up the instrument for internal a.m. and then applying f.m. from an external source.

(c) Monitoring Arrangements. A moving-coil microammeter on the front panel, used in conjunction with a crystal rectifier, continuously monitors the r.f. input to the attenuators when a spring-loaded key-switch is in the normal position; the two alternative positions are for reading f.m. deviation and a.m. depth respectively, the former by the measurement of the a.f. modulating voltage injected into the reactor valve and the latter by similarly checking the a.f. voltage being applied via the h.t.-feed circuit to the screen of whichever multiplier is operating as modulator state. The design of the modulation monitoring circuits is such that, with the Signal Generator set up for simultaneous a.m. and f.m., both percentage depth and deviation can be read independently.

(d) Power Unit. A full-wave rectifier provides all d.c. h.t. requirements; in the case of the reactor and r.f. oscillator valves the h.t. is stabilized by means of a gas-filled regulator tube. The primary of the transformer is tapped to allow for operation from 100 to 150 volts or 200 to 250 volts, and adequate r.f. filtering is introduced into the a.c. input circuit.

2. OPERATION

2.1. INSTALLATION

Unless otherwise specified, the Signal Generator is normally despatched with its valves in situ, and with its mains input circuit adjusted for immediate use with 230-volt, 40- to 100-c/s a.c. mains supplies. As detailed in the Sections which immediately follow, the instrument can, after adjustment, be operated from other supply voltages within the ranges 100 to 150 volts and 200 to 250 volts.

2.2. MAINS INPUT ARRANGEMENTS

The instrument is fitted with a mains transformer which has a double-wound primary; each primary section is tapped and the two sections can be connected in series-parallel for 100- to 150-volt operation or in series for 200- to 250-volt operation.

The mains input to the transformer is carried on two fly-leads which are connected by screws to a main tapping panel mounted on the front of the transformer. Attached to the main tapping panel, is a pierced reference plate which is reversible and marked with a selection of voltages. On one side of the reference plate, the voltages are applicable to the 100- to 150-volt range; on the other side, to the 200- to 250-volt range. The two sections of the double-wound primary are connected together by links; these links are soldered between the appropriate tags, numbered 1 to 4, which are mounted on an insulated strip at the rear of the transformer.

In order to examine the connections to the transformer and, if necessary, make adjustments, the instrument must be removed from its case.

To gain access to the interior of the instrument:

(1) Lay the instrument on its back.

(2) Extract the eight large screws from the periphery of the front panel.

(3) Withdraw the instrument from its case and separate it from the power unit attached to the bottom of the case by disengaging the 6-way, plug-and-socket connection on the top of the power unit chassis.

With the instrument removed from its case, the transformer (Reference T4 on the Circuit Diagram, and Component Layout Illustration MP 9954/1-8, which are included in this handbook) is immediately accessible.

2.2.1. For supply voltages within the range 200 to 250 volts, the numbered tags on the strip mounted on the rear of the mains transformer, MUST be linked in the following manner:-

2 to 3
No connection to 1 or 4

Also, the pierced and reversible reference plate covering the main tapping panel MUST have its side bearing the 200- to 250-volt markings uppermost. After disconnecting the screw-secured fly-leads, the reference plate remains secured by a single screw which is positioned between the "0" and "+10" tapping points; remove this screw to release the plate. Do not remove the two screws which have the tops of their heads flush with the surface of the plate.

Check that the above instructions are exactly complied with, then reposition - or check the correctness of the existing positioning of - the screw-secured fly-leads on the main tapping panel to give a combination suitable for the desired new operating voltage.

Example (1) For use on 200-volt supply mains, one fly-lead should be secured to the "200" position and the other fly-lead to the "0" position.

Example (2) For use on 250-volt supply mains, one fly-lead should be secured to the "240" position and the other fly-lead to the "+10" position.

2.2.2. For supply voltages within the range 100 to 150 volts, the numbered tags on the strip mounted on the rear of the mains transformer MUST be linked in the following manner:-

1 to 2
3 to 4

Also, the pierced and reversible reference plate covering the main tapping panel MUST have its side bearing the 100- to 150-volt markings uppermost. After disconnecting the screw-secured fly-leads, the reference plate remains secured at its centre by a single screw which is located between the "0" and "+10" tapping points; remove this screw to release the plate. Do not remove the two screws which have the tops of their heads flush with the surface of the plate.

2.2.2. (Continued)

Check that the above instructions are exactly complied with, then reposition - or check the correctness of the existing positioning of - the screw-secured fly-leads on the main tapping panel to give a combination suitable for the desired new operating voltage.

Example (1) For use on 100-volt supply mains, one fly-lead should be secured to the "100" position and the other fly-lead to the "0" position.

Example (2) For use on 150-volt supply mains, one fly-lead should be secured to the "140" position and the other fly-lead to the "+10" position.

2.3. SWITCHING ON AND WARMING UP

Ensure that the instrument is correctly adjusted - as described earlier in Sections 2.2. and 2.2.1 or 2.2.2 - to suit the particular mains supply to which it is now to be connected. Then proceed as follows:-

(1) Make connection to a suitable mains socket by means of the mains lead permanently attached to the instrument; when not in use, the mains lead stows in the left-hand case handle recess.

(2) Depress the SUPPLY switch to ON. The red pilot lamp should now glow.

(3) Before proceeding further, allow two or three minutes to elapse for the internal circuits to warm up; if a particularly high order of frequency stability is required, this time should be extended to, say, 30 minutes.

2.4. CONNECTING TO THE EQUIPMENT UNDER TEST

The r.f. output from the Signal Generator is derived via a coaxial cable permanently attached to the instrument at one end and fitted with a free plug at its other end; when not in use, the cable stows in the right-hand case handle recess.

The separate dual output impedance TERMINATING UNIT has a fixed-socket inlet which mates with the free plug on the output cable; the outlets from the TERMINATING UNIT are also fixed sockets.

2.4. (Continued)

The ATTENUATOR pad, supplied for insertion between the output cable and TERMINATING UNIT when low outputs are required, has a fixed socket at its input end and a fixed plug at its output end.

The free plug on the output cable is a Belling Lee Type L734/P and mates with the following types of Belling Lee coaxial connector:

Free socket, Type L734/J
Fixed " " L604/S (ZC 29611)
" " " L734/S
Free plug-to-socket adaptor, Type L616. (This item allows the mating of two free plugs).

The fixed-socket outlets on the TERMINATING UNIT are Belling Lee Type L734/S and mate with the following types of Belling Lee coaxial connector:

Free plug, Type L734/P (ZC 36219)
" " " L781/P

2.5. TUNING

It can be said of most signal generators, that to obtain a particular output frequency, manipulation of two controls is required; one, a "range" switch; and the other a "tuning" control.

Thus, in the TF 995A/1, appropriate setting of the RANGE switch, brings the output frequency to within one of the following bands:

2	to	13.5	Mc/s.
13.5	"	27	"
27	"	54	"
54	"	108	"
108	"	216	"

Similarly, turning the TUNE control varies the output frequency within the limits of the band selected and rotates the main dial relative to a cursor.

Since, however, the TF 995A/1 incorporates a built-in crystal calibrator, what is, in effect, a third tuning control has been incorporated. This "third control" is the cursor, its position

2.5.1. (Continued)

(a) 13.5- to 27-Mc/s Band
At 14, 15, and 16 Mc/s, and every calibration point which is a multiple of 1 Mc/s, to 27 Mc/s.

(b) 27- to 54-Mc/s Band
At 28, 30, and 32 Mc/s, and every calibration point which is a multiple of 2 Mc/s, to 54 Mc/s.

(c) 54- to 108-Mc/s Band
At 56, 60, and 64 Mc/s, and every calibration point which is a multiple of 4 Mc/s, to 108 Mc/s.

(d) 108- to 216-Mc/s Band
At 112, 120, and 128 Mc/s, and every calibration point which is a multiple of 8 Mc/s, to 216 Mc/s.

The calibrator thus allows the frequency scale to be checked at 14 different points on each of the above bands, and the adjustable cursor can be set to correspond exactly with any one of these points.

When the Signal Generator is to be used above 13.5 Mc/s to provide an output at a single spot frequency, or over a narrow band of frequencies, the cursor should be set up at the nearest crystal check point.

When the Signal Generator is to be used over a wide range of frequencies, and it is inconvenient to reset the cursor for each material frequency change, or alternatively when using the 2- to 13.5-Mc/s band, the procedure is varied to reduce the mean error to a minimum. The method of standardizing the frequency scale for subsequent general use is as follows:-

(1) Set the RANGE switch to 13.5 - 27 Mc/s.

(2) Using the headphones plugged into the CRYSTAL CHECK jack socket, tune the main dial to a crystal check point near the centre of the band, e.g., 20 Mc/s.

NOTE: When using the calibrator, the MOD SELECTOR must be set to a position other than INT MOD - F.M. or EXT MOD - F.M. This ensures that the variable oscillator is not being frequency modulated - a condition which prevents precise setting of the TUNE control for the lowest-frequency beat note in the headphones, since

2.5.1. (Continued)

it gives rise to a fluctuating tone. After using the calibrator, the Signal Generator can, of course, be subsequently set up for f.m. without invalidating any frequency calibration previously given by use of the calibrator.

(3) Adjust the milled boss in the centre of the dial to bring the cursor exactly in line with the calibration mark corresponding to the crystal check point.

NOTE: If the Signal Generator has been out of use for some time, it may be necessary to use a coin in the slot provided in order to rotate the milled boss.

(4) Check the accuracy of frequency indication at several crystal check points above and below the check point at which the cursor was set in (3) above.

(5) Readjust the cursor setting to equalize the errors over the band, e.g., it might be found that, with the frequency scale indication correct at 20 Mc/s, the indication was high at both 15 and 25 Mc/s - in such a case, the errors would be equalized by making the indication a little low at 20 Mc/s, and thus not so high at 15 and 25 Mc/s.

It will be noted that in the above procedure, the frequency scale is standardized on the 13.5- to 27-Mc/s band. This band is specified since its corresponding scale calibrations occupy the longest arc on the dial. The dial can therefore be read with a high degree of discrimination on this band and the correct cursor setting most easily determined. Once the frequency scale has been standardized on the 13.5- to 27-Mc/s band, the setting of the cursor will produce the minimum mean error on the other three direct-multiple bands. It also provides the correct cursor setting for the 2- to 13.5-Mc/s band.

When standardized in this way, the main tuning dial indication for frequencies above 13.5 Mc/s is accurate to at least 1%, and will generally be within 0.5%; for frequencies below 13.5 Mc/s, the average error does not exceed 3%.

2.5.2. Use of the incremental tuning dial

The TUNE control knob is fitted with a small incremental dial calibrated linearly from 0 to 100 over its total circumference, and makes approximately 17 revolutions as the main dial is turned through its complete angle of rotation.

This incremental dial may be used to subdivide linearly any small portion of the frequency cover on any band; the dial may be used either -

(a) to tune accurately to a frequency which is above 13.5 Mc/s but does not coincide with a crystal check point,

or (b) to make small known frequency changes when conducting bandwidth or similar determinations.

The method of using the incremental dial for application (a) above, is described in the following instructions.

(1) Set the RANGE Mc/s switch to whichever of the four higher-frequency bands embraces the required frequency.

(2) Tune the main frequency dial to the nearest crystal check point below the required frequency, identifying the point with the aid of headphones plugged into the CRYSTAL CHECK jack socket and noting the incremental TUNE dial reading which gives the lowest-frequency beat note.

(3) Tune the main frequency dial to the nearest crystal check point above the required frequency, identifying the point and noting the change in the reading of the incremental dial. It is important that the total change is noted when the dial is turned through more than one revolution.

(4) From the difference in frequency between the two crystal check points, and the total number of incremental dial divisions traversed in tuning the Signal Generator from one crystal check point to the other, calculate the incremental frequency change per division of the incremental dial; this change may conveniently be expressed in kc/s per division.

2.5.2. (Continued)

(5) With the aid of the headphones, set the main frequency dial to the crystal check point below the required frequency.

(6) Rotate the TUNE control so that the incremental dial traverses the correct number of divisions to give the required output frequency.

The following example, obtained by manipulation of the controls on a particular TF 995A/1, illustrates the use of the incremental dial to obtain an output from that instrument at an accurate frequency of 74.25 Mc/s.

Example: With the TUNE control set to the crystal check point at 72 Mc/s, the incremental dial reading was 17. With the TUNE control set to the crystal check point at 76 Mc/s the new reading on the incremental dial was 40. The total number of incremental divisions traversed was 123, the incremental dial having rotated through slightly more than one revolution for the frequency change of 4 Mc/s, i.e., 4000 kc/s.

In this case, a change of 1 division on the incremental dial corresponded, between 72 and 76 Mc/s, to a nominal frequency change of

$$\frac{4000}{123} = 32.5 \text{ kc/s}$$

Therefore, by starting from the original incremental dial setting at 72 Mc/s (72,000 kc/s) the required frequency of 74.25 Mc/s (74,250 kc/s) was obtained by rotating the incremental dial through

$$\frac{74,250 - 72,000}{32.5} = \frac{2250}{32.5} = 69 \text{ divisions}$$

It will be appreciated that since the main tuning dial on each Signal Generator Type TF 995A/1 is individually calibrated, the figure given in the above example can only be considered as typical. The example should not be taken to imply that, on the particular

2.5.2. (Continued)

Signal Generator with which this manual is issued, a change of 1 division on the incremental dial also corresponds to a frequency change of 32.5 kc/s when the instrument is tuned between 72 and 76 Mc/s. It follows that the relationship of frequency change to a change in incremental dial setting should be individually determined by the user - in the manner outlined in this Section - on the particular Signal Generator Type TF 995A/1 he is using.

The relationship should be determined between the crystal check points which embrace the particular section of the frequency band over which incremental variations are to be made. Also, the relationship should be redetermined for each different section of the frequency band, since it varies, not only from band to band, but also for different sections of any one band.

Having determined the change in frequency in kc/s for one division change in incremental dial reading, the dial can clearly also be used to make the small variations in frequency required when investigating the bandwidth of equipment under test.

The incremental dial can also, of course, be calibrated in kc/s per division for any portion of the 2- to 13.5-Mc/s band. Crystal check points cannot be used on this band, but the movement of the incremental dial for any frequency interval can be determined against the appropriate main dial calibration markings, and accurate interpolation between these marks carried out as previously described for the higher-frequency ranges.

2.6. SETTING UP FOR CONTINUOUS WAVE OR MODULATED OUTPUT

The Signal Generator includes facilities which allow the following types of r.f. output to be obtained:

(1) Continuous wave.

(2) Amplitude modulated, variable to 50% depth,

(a) from the internal a.f. oscillator at 1000 c/s;

(b) from an external sine-wave source, within the range 50 c/s to 10 kc/s.

2.6. (Continued)

(3) Frequency modulated, variable to maximum frequency deviations ranging from 25 kc/s to 600 kc/s,

(a) from the internal a.f. oscillator at 1000 c/s;

(b) from an external sine-wave source, within the range 50 c/s to 15 kc/s.

(4) Simultaneous Frequency and Amplitude Modulation, the Amplitude Modulation being obtained from the 1000-c/s internal a.f. oscillator, and the Frequency Modulation from an external source as (3) (b), above.

Sections 2.6.1 to 2.6.4 which follow, detail the different setting up procedures required to produce each of the different types of r.f. output listed above; the Sections also include the procedures for standardizing the r.f. input level to the attenuator cascade.

NOTE: When setting up for amplitude or frequency modulation as described in Sections 2.6.2 and 2.6.3, it may be observed that, with the METER READS key held to either A.M. or F.M. as applies, the actual modulation obtained is less than that indicated on the meter. This is quite in order; the meter indicates the modulation which will be obtained when the switch is returned to its central position and the meter reverts to its normal function of monitoring the r.f. level.

2.6.1. Continuous Wave

(1) Set the MOD SELECTOR switch to C.W.

(2) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

2.6.2. Amplitude Modulation

(a) From the internal 1000-c/s oscillator

(1) Set the MOD SELECTOR switch to INT MOD - A.M.

(2) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

2.6.2. (Continued)

(3) With the METER READS key switch held in the A.M. position, adjust the SET MOD control to the required modulation depth, as indicated on the top scale of the panel meter. Amplitude modulation is variable to a maximum depth of 50%.

(4) Release the METER READS key switch and, if necessary, repeat (2), above.

(b) From an external a.f. source

(1) Set the MOD SELECTOR switch to EXT MOD - A.M.

(2) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(3) Connect the external modulation source to the EXT MOD and E terminals.

(4) With the METER READS key switch held in the A.M. position, adjust the SET MOD control to the required modulation depth, as indicated on the top scale of the panel meter. With the SET MOD control at maximum, an input of approximately 15 volts r.m.s. is required at the EXT MOD and E terminals to produce 30% modulation depth within the modulation frequency range, 50 c/s to 10 kc/s.

(5) Release the METER READS key switch and, if necessary, repeat (2), above.

2.6.3. Frequency Modulation

In addition to the MOD SELECTOR switch, there are three other controls concerned in setting up the carrier deviation when the output from the Signal Generator is to be frequency modulated. These controls are the continuously-variable SET MOD potentiometer, the DEVIATION RANGE switch, and the DEVIATION - NORMAL/HIGH switch. When the METER READS key switch is held to F.M., the panel meter indicates deviation. The meter has two deviation scales: one calibrated from 0 to 25 kc/s, and the other from 0 to 75 kc/s.

With the DEVIATION - NORMAL/HIGH switch set to NORMAL, the meter scale appropriate to the setting of the DEVIATION RANGE switch is used and the deviation is as indicated by the meter for all settings of the carrier-frequency RANGE switch.

2.6.3. (Continued)

With the DEVIATION - NORMAL/HIGH switch set to HIGH, the deviation obtained on the 13.5- to 27-Mc/s band is the same as with the switch set to NORMAL. For all other carrier-frequency bands the deviation is increased and the meter readings - again, taken on the scale appropriate to the setting of the DEVIATION RANGE switch - must be multiplied in accordance with TABLE 1.

TABLE 1

Carrier frequency RANGE switch setting (Mc/s)	Deviation RANGE switch setting (kc/s)	If DEVIATION - NORMAL/HIGH switch set to HIGH	
		Multiply meter reading by	Maximum deviation obtainable (kc/s)
2 - 13.5	25	2	50
	75	2	150
13.5 - 27	25	1	25
	75	1	75
27 - 54	25	2	50
	75	2	150
54 - 108	25	4	100
	75	4	300
108 - 216	25	8	200
	75	8	600

2.6.3. (Continued)

The following examples show the method of determining the meter reading for a required deviation which is greater than 75 kc/s and thus necessitates setting the DEVIATION - NORMAL/HIGH switch to HIGH.

Example 1: A deviation of 160 kc/s is required at a carrier frequency of 80 Mc/s. The carrier frequency lies within the 54- to 108-Mc/s band. The meter multiplying factor for this band is 4; therefore, for 160 kc/s deviation, the meter should be set (by means of the SET MOD control) to read

$$\frac{160}{4} = 40 \text{ kc/s}$$

Do this on the bottom scale of the meter with the DEVIATION RANGE switch set to 75 kc/s.

Example 2: A deviation of 160 kc/s is required at a carrier frequency of 120 Mc/s. The carrier frequency lies within the 108- to 216-Mc/s band. The meter multiplying factor for this band is 8; therefore, the meter should be set (by means of the SET MOD control) to read

$$\frac{160}{8} = 20 \text{ kc/s}$$

Do this on the middle scale of the meter with the DEVIATION RANGE switch set to 25 kc/s.

(a) F.M. from the internal 1000-c/s oscillator

(1) Set the MOD SELECTOR switch to INT MOD - F.M.

(2) Set the DEVIATION RANGE switch as required. If, at carrier frequencies less than 13.5 Mc/s, or greater than 27 Mc/s, more than 75 kc/s deviation is required, set the DEVIATION - NORMAL/HIGH switch to HIGH. (Deviations greater than 75 kc/s are not obtainable

2.6.3. (Continued)

on the 13.5- to 27-Mc/s carrier-frequency band, the maximum deviations obtainable on the other carrier-frequency bands are given in TABLE 1 on page 20.)

(3) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(4) With the METER READS key switch held to F.M., adjust the SET MOD control until the required deviation is indicated on the panel meter; read the meter on its middle scale when the DEVIATION RANGE switch is set to 25 kc/s, and read on the lower scale when the switch is set to 75 kc/s. If the DEVIATION - NORMAL/HIGH switch is set to HIGH, the meter readings must be multiplied by the appropriate factor given in TABLE 1.

(5) Release the METER READS key switch and, if necessary, repeat (3), above.

(b) F.M. from an external source

(1) Set the MOD SELECTOR switch to EXT MOD - F.M.

(2) Set the DEVIATION RANGE switch as required. If at carrier frequencies less than 13.5 Mc/s, or greater than 27 Mc/s, more than 75 kc/s deviation is required, set the DEVIATION - NORMAL/HIGH switch to HIGH. (Deviations greater than 75 kc/s are not obtainable on the 13.5- to 27-Mc/s carrier-frequency band; the maximum deviations obtainable on the other carrier-frequency bands are given in TABLE 1 on page 20.)

(3) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(4) Couple the external modulation source to the EXT MOD and E terminals.

(5) With the METER READS key switch held to F.M., adjust the SET MOD control until the required deviation is indicated on the panel meter; read the meter on its middle scale when the DEVIATION

2.6.3. (Continued)

RANGE switch is set to 25 kc/s, and read on the lower scale when the switch is set to 75 kc/s. If the DEVIATION - NORMAL/HIGH switch is set to HIGH, the meter readings must be multiplied by the appropriate factor given in TABLE 1.

For any settings of the DEVIATION RANGE and DEVIATION - NORMAL/HIGH switches, and within the modulation frequency range 50 c/s to 15 kc/s, approximately 25 volts r.m.s. is required between the EXT MOD and E terminals for full deviation. With respect to 1 kc/s, the frequency characteristic of the modulation system is flat to within ±1 dB from 50 c/s to 15 kc/s.

2.6.4. Simultaneous Frequency and Amplitude Modulation

(1) Set up the required depth of amplitude modulation as detailed in Section 2.6.2. (a).

(2) Leaving the MOD SELECTOR switch at INT MOD - A.M., and without altering the setting of the SET MOD control, set up the required deviation in a similar manner to that detailed in Section 2.6.3. (b); in this case, adjust the amount of deviation by variation of the audio input from the external modulation source.

2.7. R.F. OUTPUT ARRANGEMENTS

Five factors affect the output level from the Signal Generator; these factors are :

(a) The SET CARRIER control whose setting determines the input level to the attenuator cascade.

(b) The "coarse" or OUTPUT VOLTAGE attenuator.

(c) The "fine" or MULTIPLY BY attenuator.

(d) The TERMINATING UNIT which plugs on the end of the output cable from the fine attenuator.

(e) The ATTENUATOR PAD which is interposed between the output cable and TERMINATING UNIT when especially low output levels are required.

2.7. (Continued)

The SET CARRIER control is adjusted in conjunction with the panel meter; with the METER READS key switch in its central position, the panel meter forms part of a crystal voltmeter which monitors the input to the coarse attenuator. The panel meter has three main marks on its scale; these marks are minus 1 dB, SET R.F., and plus 1 dB respectively. Normally, the SET CARRIER control should be adjusted to bring the meter pointer to the SET R.F. mark.

Four 20-dB steps give the coarse or OUTPUT VOLTAGE attenuator a total range of 80 dB; each setting of the attenuator control has markings in red and in white. The red markings are in terms of decibels relative to 1 μV; the white markings are directly in units of voltage.

Ten 2-dB steps give the fine or MULTIPLY BY attenuator a total range of 20 dB; each setting of the attenuator control has markings in red and white, the red markings being in terms of decibels relative to 1 μV, and the white markings, multiplying factors for the white voltage-markings on the coarse attenuator.

Both attenuators have a characteristic impedance of 75 ohms and, "looking into" the coaxial plug at the end of the output cable, the instrument appears as a generator with a source impedance of 75 ohms.

The TERMINATING UNIT is, in essence, a 6-dB attenuator pad; "looking into" its input socket, the TERMINATING UNIT presents an impedance of 75 ohms, while the two outlets present impedances of 52 and 75 ohms respectively.

The ATTENUATOR PAD Type TM 4736 has a characteristic impedance of 75 ohms and provides an optional, additional, 20-dB attenuation of the output signal.

It should be noted particularly that the r.f. output controls on the Signal Generator are calibrated in terms of source e.m.f. or open-circuit output voltage. The significance of quoting the output of a signal generator in this way, will be apparent when it is remembered that one of the primary functions of a signal generator is to simulate a received signal as it would come from an aerial.

To take a simple case - that in which a 75-ohm receiver is fed from a 75-ohm dipole, the e.m.f. induced in the aerial is shared between its inherent 75-ohm radiation resistance and the matched

2.7. (Continued)

75-ohm receiver input. Clearly, when the same receiver is fed from a signal generator, the corresponding signal strength is given by the source e.m.f. of the signal generator, and not by the on-load p.d. at the receiver terminals.

2.7.1. Outputs from 1 μV to 100 mV at 52 and 75 ohms

It is intended that the Signal Generator should normally be used with the SET CARRIER control adjusted to bring the meter pointer to the SET R.F. mark; with the TERMINATING UNIT coupled directly to the output cable; and, without the ATTENUATOR PAD Type TM 4736.

Used in this way, the Signal Generator should be regarded as a source of zero impedance in series with a resistance of either 75 ohms or 52 ohms, the open-circuit output level, or source e.m.f., being variable in 2-dB steps from 1 μV to 100 mV and being given

(a) directly in terms of decibels relative to 1 μV, by the sum of the "red" settings of the OUTPUT VOLTAGE and MULTIPLY BY attenuators;

(b) directly in voltage, by the product of the "white" settings of the OUTPUT VOLTAGE and MULTIPLY BY attenuators.

The plus 1-dB and minus 1-dB marks on the panel meter allow interpolation between the 2-dB steps of the MULTIPLY BY attenuator. Setting the meter pointer to either the plus 1-dB or minus 1-dB mark, increases or decreases the input to the attenuator cascade by 1 decibel. Thus, using the SET CARRIER control and panel meter in conjunction with the OUTPUT VOLTAGE and MULTIPLY BY attenuators, the output level from the Signal Generator can be varied in 1-dB steps over the range 0 to +100 dB relative to 1 μV.

It should be noted that the "white" voltage indication given by the attenuator controls is not directly applicable when the meter is set to other than the SET R.F. mark; with the meter at minus 1 dB, the source e.m.f. at the TERMINATING UNIT outlets is 0.89 of the indicated voltage; with the meter at plus 1 dB, the source e.m.f. is 1.12 of the indicated voltage.

2.7.2. Outputs from 2 μV to 200 mV at 75 ohms only

With the TERMINATING UNIT detached, the output level obtained directly from the plug at the end of the r.f. output cable is variable in the range 2 μV to 200 mV and is derived via a source impedance of 75 ohms.

Under these conditions the open-circuit output level, or source e.m.f., in terms of decibels relative to 1 μV is obtained by adding 6 dB to the sum of the meter reading and the "red" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators; with the meter at the SET R.F. mark, the source e.m.f. is given directly in voltage by doubling the product of the "white" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators.

2.7.3. Outputs from 0.1 μV to 10 mV at 52 and 75 ohms

With the TERMINATING UNIT coupled to the r.f. output cable via the 20-dB ATTENUATOR PAD, the output level from the TERMINATING UNIT is variable in the range 0.1 μV (nominal) to 10 mV.

In this case, the source e.m.f. in terms of decibels relative to 1 μV is obtained by subtracting 20 dB from the sum of the meter reading and the "red" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators; with the meter at the SET R.F. mark, the source e.m.f. is given directly in voltage by multiplying the product of the "white" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators by 0.1.

2.7.4. Output in terms of voltage developed across an external load

For some particular applications, it may be desired to work not in terms of source e.m.f. as indicated by the meter and attenuator controls, but in terms of actual voltage developed across the external load. This on-load, or terminal voltage, is given by the expression

$$V_L = E \times \frac{Z_L}{Z_0 + Z_L} \quad \text{.....(1)}$$

where V_L = actual voltage developed across the external load.

E = the source e.m.f. of the Signal Generator.

Z_L = the impedance of the external load.

2.7.4. (Continued)

Z_0 = the source impedance of the Signal Generator; (with the TERMINATING UNIT in use, Z_0 = 75 or 52 Ω; with the TERMINATING UNIT removed, Z_0 = 75 Ω).

The expression is based on the assumption that the external load impedance Z_L is essentially resistive. Where Z_L is not essentially resistive, it may be necessary for the user to revise the expression to take account of the reactive component of the load.

A series of multiplying factors, which can be used to convert from source e.m.f. to actual voltage developed across an external resistive load, and which have been derived with the aid of the above expression, are given in TABLE 2 for a selection of typical load values.

TABLE 2

External load impedance in ohms	Approximate multiplying factor to convert from source e.m.f. to actual voltage developed across an external resistive load	
	Z_0 = 75 Ω	Z_0 = 52 Ω
10	0.12	0.16
20	0.21	0.28
30	0.29	0.36
40	0.35	0.43
50	0.4	0.49
52	0.41	0.5
60	0.44	0.53
70	0.48	0.57
75	0.5	0.59
80	0.51	0.61
100	0.57	0.65
150	0.67	0.74
200	0.73	0.79
300	0.8	0.85
500	0.87	0.9

2.7.5. Matching to external loads other than 52 or 75 ohms

The TERMINATING UNIT supplied with the Signal Generator allows r.f. outputs to be obtained from a source impedance of either 52 or 75 ohms.

If the equipment under test has an input impedance of other than 52 or 75 ohms, and if it is required to present the equipment with a signal derived from a matched source, then it is necessary to modify the output arrangements of the Signal Generator. The simple modifications required are described in sub-sections (a) and (b) which follow: in these sub-sections it is assumed that the TERMINATING UNIT is in circuit, and that the 20-dB ATTENUATOR PAD is out of circuit.

(a) If the impedance of the external load is less than that of the TERMINATING UNIT outlet in use, the impedance presented to the load can be made equal to the load impedance by shunting the TERMINATING UNIT outlet with a single resistor, R_p, where

$$R_p = \frac{Z_0 \times Z_L}{Z_0 - Z_L} \quad \text{.....(2)}$$

and where Z_0 = the source impedance of the Signal Generator at the TERMINATING UNIT outlet in use.

Z_L = the impedance of the external load.

Under these conditions, the relationship between E_{SG}, the e.m.f. indicated by the attenuator controls on the Signal Generator, and E_{EFFECT}, the effective source e.m.f. presented to the external load, is given by the expression

$$E_{SG} = E_{EFFECT} \times \frac{R_p + Z_0}{R_p} \quad \text{.....(3)}$$

Example: It is required to provide a signal of 25 μV effective source e.m.f. at a source impedance of 20 ohms.

2.7.5. (Continued)

Since the new source impedance is to be 20 ohms, the output is taken from the 52-ohm outlet on the TERMINATING UNIT, the 52-ohm outlet being chosen in preference to the 75-ohm outlet to obtain the minimum reduction from E_{SG} to E_{ERROR}.

From expression (2) above, the value of the resistor, R_x, which is to be connected in parallel with the 52-ohm outlet of the TERMINATING UNIT, is

$$\frac{52 \times 20}{52 - 20} = 325 \Omega$$

From expression (3), the attenuator controls on the Signal Generator should be set to indicate

$$25 \times \frac{325 + 52}{325} = 30 \mu V$$

The attenuators cannot be set to indicate exactly 30 μV and they should therefore be set to 31 μV - the setting nearest to the required value for E_{SG}. 30 μV is approximately -0.3 dB relative to 31 μV and, if desired, the user may obtain an E_{SG} nearer to 30 μV by adjustment of the SET CARRIER control to bring the meter pointer to an estimated -0.3 dB.

As a result of shunting the output of the TERMINATING UNIT with 325 ohms and setting the attenuator controls in the manner described, the equipment under test is fed from a source whose effective output impedance is 20 ohms and whose effective source e.m.f. is 25 μV; the actual voltage developed across the input impedance of the equipment under test is, of course, 12.5 μV.

2.7.5. (Continued)

Since the new source impedance is to be 20 ohms, the output is taken from the 52-ohm outlet on the TERMINATING UNIT, the 52-ohm outlet being chosen in preference to the 75-ohm outlet to obtain the minimum reduction from E_{SG} to E_{EFFECT}.

From expression (2) above, the value of the resistor, R_p, which is to be connected in parallel with the 52-ohm outlet of the TERMINATING UNIT, is

$$\frac{52 \times 20}{52 - 20} = 325\ \Omega$$

From expression (3), the attenuator controls on the Signal Generator should be set to indicate

$$25 \times \frac{325 + 52}{325} = 30\ \mu V$$

The attenuators cannot be set to indicate exactly 30 μV and they should therefore be set to 31 μV - the setting nearest to the required value for E_{SG}. 30 μV is approximately -0.3 dB relative to 31 μV and, if desired, the user may obtain an E_{SG} nearer to 30 μV by adjustment of the SET CARRIER control to bring the meter pointer to an estimated -0.3 dB.

As a result of shunting the output of the TERMINATING UNIT with 325 ohms and setting the attenuator controls in the manner described, the equipment under test is fed from a source whose effective output impedance is 20 ohms and whose effective source e.m.f. is 25 μV; the actual voltage developed across the input impedance of the equipment under test is, of course, 12.5 μV.

2.7.5. (Continued)

(b) If the impedance of the external load is greater than that of the TERMINATING UNIT outlet in use, the impedance presented to the load can be made equal to the load impedance by connecting a single resistor, R_S, in series with the Signal Generator output. The value of R_S is given by the expression

$$R_S = Z_L - Z_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where Z_L = the impedance of the external load.

Z_0 = the source impedance of the Signal Generator at the TERMINATING UNIT outlet in use.

Under these conditions, the effective source e.m.f. (E_{EFFECT}) of the Signal Generator and series resistor combined, equals the source e.m.f. (E_{SG}) of the Signal Generator alone,

$$\text{i.e.,} \quad E_{SG} = E_{EFFECT} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Example: It is required to provide a signal of 10 μV effective source e.m.f. at a source impedance of 300 ohms.

Since the new output impedance is greater than either 52 or 75 ohms, there is no advantage to be gained by using one of the TERMINATING UNIT outlets in preference to the other; in this example it is assumed that the 75-ohm outlet is used.

From expression (4) above, the value of the resistor, R_S, which is to be connected in series with the "live" connection between the Signal Generator and the equipment under test, is

$$300 - 75 = 225\ \Omega$$

2.7.5. (Continued)

From expression (5), the attenuators on the Signal Generator should be set to indicate

10 μV

In this way, the equipment under test is fed from a source whose effective impedance is 300 ohms and whose effective source e.m.f. is 10 μV; the actual voltage developed across the input impedance of the equipment under test is, of course, 5 μV.

2.7.6. Matching to balanced loads

The preceding Sections dealing with r.f. output arrangements are based on the supposition that the equipment being fed from the Signal Generator has an unbalanced input circuit.

With certain types of equipment, the input circuit is in the form of a balanced winding; such equipment can be fed from the unbalanced output of the Signal Generator by interposing two loading resistors between the TERMINATING UNIT outlet and the ends of the balanced input winding.

One resistor, R_1, is connected in series between the earth connection of the TERMINATING UNIT outlet in use and one side of the balanced winding; the other resistor, R_2, is connected in series between the "live" connection of the TERMINATING UNIT outlet in use and the other side of the balanced winding.

Values for R_1 and R_2 may be computed from the following expressions

$$R_1 = \frac{Z_{LB}}{2} \quad \ldots\ldots\ldots\

2.7.6. (Continued)

With the equipment under test and the TERMINATING UNIT of the Signal Generator interconnected via R_1 and R_2 as described above, the source e.m.f. (E_{SG}) indicated by the Signal Generator controls is equal to the effective line-to-line source e.m.f. (E_{EFFECT}) seen by the equipment under test.

Example (1) It is required to match the 75-ohm outlet of the TERMINATING UNIT to a balanced winding whose total line-to-line impedance is 150 ohms.

From expression (6) above, the value of R_1 is

$$\frac{150}{2} = 75\ \Omega$$

From expression (7) the value of R_2 is

$$\frac{150}{2} - 75 = 0$$

R_1 is connected in series between the earth connection of the TERMINATING UNIT and one side of the balanced winding; R_2 being zero, the "live" connection of the 75-ohm outlet is connected directly to the other side of the balanced winding.

Example (2) It is required to match the 75-ohm outlet to a balanced winding whose total line-to-line impedance is 200 ohms.

From expression (6) above, the value of R_1 is

$$\frac{200}{2} = 100\ \Omega$$

From expression (7) the value of R_2 is

$$\frac{200}{2} - 75 = 25\ \Omega$$

2.7.6. (Continued)

R_1 is connected in series with the earth connection of the TERMINATING UNIT and one side of the balanced winding; R_2 is connected in series with the "live" connection between the TERMINATING UNIT and the other side of the balanced winding.

A special TERMINATING UNIT, Type TM 5084, which matches the 75-ohm output of the TF 995A/1 to a balanced winding by the method described above, is available as an accessory and is supplied if specially ordered. This unit has two outlets and is for use with a balanced winding having a line-to-line impedance of either 240 or 300 ohms.

2.8. SYNCHRONIZING SIGNAL

A 1000-c/s sine wave signal, derived from the internal a.f. oscillator, is available between the SYNC and E terminals of the instrument when the MOD SELECTOR switch is set at either of the INT MOD positions. This signal has an open-circuit level of the order of 100 volts and is derived via a source impedance of approximately 250 kΩ.

When an output from the equipment under test is being viewed on a cathode-ray oscilloscope, it will often be found convenient to lock the c.r.o. time base directly with the SYNC signal rather than with the actual signal being viewed.

The SYNC output can, of course, also be used when an audio frequency signal is required for the equipment under test.

3. OPERATIONAL SUMMARY

When the user is familiar with the principles and techniques of operation detailed in Section 2 of this handbook, the following abridged operating instructions may be found convenient.

ABRIDGED OPERATING INSTRUCTIONS

Frequency Range:-
2 to 216 Mc/s

Source Impedance:-
Without TERMINATING UNIT: 75 Ω
With TERMINATING UNIT: 52 and 75 Ω

Maximum Output:-
Without TERMINATING UNIT: 0.2V
With TERMINATING UNIT: 0.1V

Power Supply:-
100 to 150V, 40 to 100 c/s
200 to 250V, 40 to 100 c/s

Check correctness of mains transformer tappings before use

STANDARDIZING THE FREQUENCY SCALE

Switch mains ON and set RANGE MC/S switch to 13.5 - 27; with MOD SELECTOR switch set to other than INT MOD - F.M. or EXT MOD - F.M., and using headphones plugged into CRYSTAL CHECK socket, tune main dial to crystal check point near centre of band. Bring movable cursor in line with dial calibration corresponding to crystal check point. Check accuracy of frequency indication above and below point to which cursor was originally set. Equalize errors over band by readjusting cursor.

TUNING

Set RANGE MC/S switch to band required; rotate TUNE control until cursor indicates required frequency. For higher frequency-accuracy, compute relationship of frequency change to change in incremental dial setting between crystal check points or scale markings embracing required frequency. Starting from selected point below required frequency, rotate TUNE control so that incremental dial traverses calculated number of divisions.

C.W. OPERATION

With the MOD SELECTOR switch set to C.W., adjust SET CARRIER to bring meter pointer to SET R.F.; adjust step attenuators to obtain required output level.

3. (Continued)

AMPLITUDE MODULATION

INTERNAL: With MOD SELECTOR switch at INT MOD - A.M., adjust SET CARRIER to bring meter pointer to SET R.F. With METER READS switch at A.M., adjust SET MOD to bring meter pointer to required modulation depth. Release METER READS switch and, if necessary, readjust SET CARRIER; adjust step attenuators to obtain required output level.

EXTERNAL: As for internal, except that the MOD SELECTOR switch is set to EXT MOD - A.M., and external signal injected between EXT MOD and E terminals. Approximately 15 volts r.m.s. (50 c/s to 10 kc/s) is required to produce 30% modulation.

FREQUENCY MODULATION

INTERNAL: With MOD SELECTOR switch at INT MOD - F.M., adjust SET CARRIER to bring meter pointer to SET R.F. With DEVIATION - NORMAL/HIGH switch at NORMAL, and METER READS switch at F.M., adjust SET MOD to bring meter pointer to required deviation on meter scale appropriate to DEVIATION RANGE switch setting. (For deviations greater than 75 kc/s, set DEVIATION - NORMAL/HIGH switch to HIGH and multiply meter readings by factor given in TABLE 1, Section 2.6.3.) Release METER READS switch and, if necessary, readjust SET CARRIER; adjust step attenuators to obtain required output level.

EXTERNAL: As for internal, except that the MOD SELECTOR switch is set to EXT MOD - F.M. and external signal injected between EXT MOD and E terminals. Approximately 25 volts r.m.s. (50 c/s to 15 kc/s) is required to produce full deviation.

SIMULTANEOUS FREQUENCY AND AMPLITUDE MODULATION

Set up as for AMPLITUDE MODULATION, INTERNAL. Then, with the MOD SELECTOR switch still set at INT MOD - A.M., apply external signal (50 c/s to 15 kc/s) between EXT MOD and E terminals. Adjust level of external signal to produce required deviation; do not readjust SET MOD control.

4. MAINTENANCE

4.1. GENERAL

The following items (for details see APPENDICES, page 52) are included in this handbook to assist in the maintenance of the Signal Generator Type TF 995A/1:-

- Block Schematic Diagram.
- Complete Circuit Diagram.
- Component Layout Illustrations:-
  - Front Panel.
  - General Underside View from rear (case removed).
  - L.F. and R.F. Units (top view with R.F. Unit screening cover removed).
  - R.F. Unit (general underside view).
  - R.F. Unit (close-up of portion of underside).
  - L.F. Unit (underside view).
  - Attenuators (covers removed).
  - Power Unit.
- Spares Ordering Schedule with Circuit References.
- Valve Replacement Data Sheets.

Section 1, DESCRIPTION, of this handbook deals with the internal circuits of the Signal Generator and is intended to be read in conjunction with the Block Diagram; it is strongly recommended that the user should familiarize himself with the principles described in Section 1, and illustrated in the Block Diagram, before commencing the adjustment or replacement of component parts of the instrument.

The complete Circuit Diagram shows all the electrical components contained in the instrument. The description of these components - their type, value, rating, etc. - is given in the Spares Ordering Schedule; the Schedule also lists certain selected mechanical components.

The physical location of the electrical components is shown on the Component Layout Illustrations.

4.2. REPLACEMENT OF VALVES AND CRYSTALS

The types of valve used in the instrument, their base connections, and some guidance as to suitable alternatives if the types originally fitted are not readily available, are given in the Valve Replacement Data Sheets.

The valves and crystals may normally be replaced without special selection. Valves, V1, V5, V9, V11 and V13, are immediately accessible on removing the instrument from its case in the manner described in Section 2.2; to gain access to the 333.3-kc/s oscillator crystal, X1, and to the remaining valves, remove the screening cover from the R.F. Unit in the manner described in Section 4.4.1. The crystal rectifier X2 is housed in the main compartment of the coarse attenuator assembly and can be removed as detailed in Section 4.4.3.

Replacement of V2, V13, or X2, may necessitate the reselection of associated components; aspects of this reselection are discussed in Section 4.5 - Replacement of Components of Specially Selected Value.

4.3. WORKING VOLTAGES

Measured with a Model 40 Avometer set to its highest convenient range, the h.t. and l.t. voltages should be of the following orders:

Mains Transformer,	h.t. secondary:	250-0-250 V a.c. ± 10% overall.
" "	rectifier l.t.:	5 V a.c. ± 5%.
" "	main l.t.:	6.3 V a.c. ± 5%.
H.T. rectified (V11, pin 8):		300 V d.c. ± 10%.
H.T. smoothed, HT1, (across C62):		250 V d.c. ± 10%.
H.T. stabilized, HT3, (V9, pin 5):		150 V d.c. ± 10%.

Valve electrode voltages are given in TABLE 3.

All the voltages listed are quoted with respect to chassis and are subject to a tolerance of ± 20%; except where alternative instructions are given, they should be measured with the MOD SELECTOR switch set to INT MOD - A.M., the RANGE MC/S switch to 108-216, the SET CARRIER control to maximum, and the SET MOD control to minimum.

4.3. (Continued)

TABLE 3

Valve No.	Va	Vg_2	Vk
V1	205	42	1.2
V2	150	150	8.7
V3	150	60	-
V4	25	25	-
V5	255	255	3.6 50**
V6	100	130	-
V7 (osc)*	230	-	-
V7 (amp)*	255	-	2.3
V8	85	130	-
V10	130	130	-
V12	145	55	-

* When checking V7 voltages, set the RANGE MC/S switch to 2 - 13.5.

** The cathode potential of V5 increases to 50 volts when the MOD SELECTOR switch is set to INT MOD - F.M.

4.4. ACCESS TO ENCLOSED SUB-ASSEMBLIES

General tests, or some peculiarity in the performance of the Signal Generator, may suggest the desirability of inspecting the interior of one of the enclosed sub-assemblies which form part of the instrument; any of these sub-assemblies can be dismantled by following the appropriate procedure detailed in the following sections.

4.4.1. R.F. Unit

To remove the screening cover from the r.f. unit, proceed in the following manner:

(1) With the instrument removed from its case, lay it on its face.

(2) Extract the two screws which secure the r.f. unit screening cover in position.

(3) Grip the sides of the screening cover and draw it off; the edges of the open end of the cover are gripped by a spring system of earthing contacts and the cover will consequently offer some resistance to removal.

When replacing the screening cover, care should be taken that its edges are correctly engaged with the earthing contacts before it is pushed home.

4.4.2. Fine Attenuator

A view of the fine attenuator with its screening cover removed is shown in Component Layout Illustration MP 995A/1-7. To dismantle the attenuator, proceed in the following manner:

(1) Remove the attenuator screening cover after extracting its single securing screw.

(2) Remove the front-panel control knob after slackening the two grub screws which secure it to its associated spindle.

(3) Detach the main body of the attenuator from the front panel by extracting five screws; three of these screws are immediately visible on removal of the control knob as in (2) above; the two remaining screws are located immediately above the 8- and 12-dB panel markings respectively.

With the attenuator detached as in (3) above, it remains coupled to the body of the instrument by two coaxial leads; these leads are normally sufficiently long to permit inspection and, if necessary, replacement of the attenuator resistors without completely disconnecting the attenuator.

4.4.2. (Continued)

Replace the fine attenuator in the reverse order to that detailed above.

4.4.3. Coarse Attenuator

The coarse attenuator assembly comprises two main compartments: a rear compartment containing the filter components of the crystal rectifier circuit; a forward compartment containing the crystal rectifier X2 and the resistors which comprise the coarse attenuator proper. When dismantling the coarse attenuator the user should refer to Component Layout Illustration MP 995A/1-7.

Access to X2 is obtained by carrying out operations (1) and (2) detailed below; carrying out operations (1) to (3) inclusive allows inspection of the crystal-rectifier filter components C88, C89, R71, and R72; by following the entire procedure the whole coarse attenuator assembly can be detached from the front panel of the instrument.

(1) Unsolder C90 and R70 from the feed-through pillar which projects through the crystal-rectifier filter screening cover.

(2) Remove the attenuator screening cover after extracting its single securing screw; this screw also holds the insulated mounting tag to which R70 is connected.

(3) Remove the crystal-rectifier filter screening cover by extracting the three screws securing it to the coarse attenuator screening cover.

(4) Remove the front-panel control knob after slackening the two grub screws securing it to the spindle.

(5) Detach the main body of the attenuator from the front panel by extracting five fixing screws; three of these screws are immediately visible on removing the control knob as in (4) above; the two remaining screws are located immediately above and to the right of the coarse-attenuator panel markings.

4.4.3. (Continued)

With the attenuator detached as in (5) above, it remains coupled to the body of the instrument by two coaxial cables. These cables are, however, normally long enough to permit inspection and, if necessary, replacement of the attenuator resistors without completely disconnecting the attenuator.

Reassemble the coarse attenuator in the reverse order to that detailed above.

4.4.4. Mains Input Filter Unit

To gain access to the components comprising the mains input filter, proceed as follows:

(1) Remove the nut and screw which secure, at the open end, the two halves of the mains filter unit screening cover.

(2) Separate the push-fit screening channel from the fixed half of the filter unit screening cover. This removable channel fits inside the fixed half of the screening cover.

The mains input filter unit components are now easily accessible.

Reassemble the screening cover in the reverse order to that detailed above.

4.4.5. Power Unit

To remove the power unit from the instrument case proceed as follows:

(1) Remove, from the underside of the instrument case, the five screws which engage with nuts along the front and left-hand flanges of the power unit chassis.

(2) Finally, holding the power unit with one hand, remove the remaining two screws which engage with tapped bushes on the right-hand flange of the power unit.

4.4.5. (Continued)

Replace the power unit in the reverse order to that detailed above.

4.5. REPLACEMENT OF COMPONENTS OF SPECIALLY SELECTED VALUE

It is often necessary in the design of an electronic instrument to designate certain components for individual selection during the factory calibration of the instrument; this selection is required since the operating characteristics of the instrument have to conform to a quantitative specification including maximum and minimum limits of permissible error.

Those components which are selected in this way in the TF 995A/1 are given only nominal or average values in the Description column of the Spares Ordering Schedule and are distinguished by an asterisk mark.

If, in servicing a TF 995A/1, it is necessary to replace any of these selected components, then, if the performance or accuracy of the instrument it is not to be impaired, it is necessary to repeat the factory calibration procedure by which the components were originally selected.

Sections 4.6 to 4.6.18 give a range of tests by which the main points of the performance of the instrument can be checked; the sections also deal with the choice of value for individually selected components. TABLE 4 lists these components together with the number of the section in which their selection is described.

It will be appreciated that it may sometimes be necessary to reselect a selected component even though that component itself has not been found faulty and replaced in initial servicing operatings. To take an example - the internal modulation oscillator is tuned by T1 and C6. In manufacture, T1 is regarded as a fixed component and C6 is selected to give an oscillator frequency of 1000 c/s ± 5%. In servicing the instrument it might be found that T1 was faulty but that C6 was not. If T1 was replaced then it would be quite likely that with the original C6, the oscillator frequency would be outside the specified limits of ±5% and that a C6 of a new value would have to be chosen.

It therefore follows that, in all servicing involving replacement of components, the user should consider carefully the

4.5. (Continued)

possible effects on the performance of the stage or stages involved; if individually selected components form part of those stages then it may be necessary to reselect them although they themselves have not been found faulty.

TABLE 4

Selected Component	Section Describing Selection
R2	4.6.12
R5	4.6.10
R6	4.6.10
R8	4.6.10
R9	4.6.10
R11	4.6.10
R12	4.6.10
R13	4.6.10
R14	4.6.10
R19	4.6.11
R24	4.6.12
R39	4.6.17
R63	4.6.16
R66	4.6.13
R67	4.6.13
R68	4.6.13
R69	4.6.13
R70	4.6.8
C6	4.6.9

4.6. SCHEDULE OF TESTS

The following information is based on abstracts from the internal Factory Test Schedule TS 995A/1.

4.6.1. Apparatus Required

(a) 750-volt Insulation Tester.
(b) AvoMeter, model 40.
(c) Wave Analyser, Marconi Type TF 455 (Series).
(d) Signal Generator, with standardized output, Marconi Type TF 801 (Series) or TF 995 (Series).
(e) Valve Voltmeter, Marconi Types TF 428 (Series) or TF 958.
(f) A.M. Communication Receiver, covering the range 2 to 220 Mc/s.
(g) Micro-ammeter, f.s.d. 50 μA.
(h) 1-MΩ and ½-MΩ resistors.
(i) Beat Frequency Oscillator, Marconi Types TF 195 (Series) or TF 894 (Series)
(j) Cathode Ray Oscilloscope.
(k) Deviation Meter, Marconi Types TF 791B or TF 934.

4.6.2. Insulation (Apparatus required:- Item a)

Test the insulation between each pin of the supply plug and chassis with SK1 engaged and disengaged. The reading should be not less than 40 MΩ.

4.6.3. Hum Level (Apparatus required:- Item c)

Measure the 100-c/s hum level using a wave analyser isolated from the TF 995A/1 by means of a suitable capacitor. The hum level should not exceed 20 mV as measured at the H.T.1 point.

4.6.4. Crystal Oscillator (Apparatus required:- Item e)

Plug head telephones into the CRYSTAL CHECK socket and turn the TUNE control until an audio beat is heard; adjust the core of L8 for maximum intensity of the audio note.

Measure the voltage across R27 with a valve voltmeter; it should be between 8 and 10 volts.

4.6.5. Basic Oscillator (Apparatus required:- Items e, and f)

Set the MOD SELECTOR switch to C.W. and the Main Dial to 27 Mc/s. Using a receiver as indicator, adjust C35 until the circuit oscillates at 9.0 Mc/s. Set the Main Dial to 13.5 Mc/s and adjust the core of T2 until the circuit oscillates at 4.5 Mc/s. Repeat these two adjustments.

Measure the r.f. voltages at the grid and anode of V3 using a valve voltmeter. These should be of the following orders:-

	4.5 Mc/s	9.0 Mc/s
Grid	2.2 volts	4 volts
Anode	22 volts	35 volts

Finally, re-check the tuning adjustments against the crystal by means of high-resistance headphones plugged into the CRYSTAL CHECK socket. Fourteen check points should be heard.

4.6.6. Frequency Multipliers (Apparatus required:- Items f, g, and h)

Set the MOD SELECTOR switch to C.W., the RANGE MC/S switch to 13.5 - 27, and the SET CARRIER control fully clockwise. Connect a 50-μA meter in series with a 1-MΩ resistor between the grid of V8 and chassis. Set the Main Dial to 13.5 Mc/s and adjust the core of T3 for maximum deflection on the meter. Set the Main Dial to 27 Mc/s and adjust C47 for maximum deflection on the meter. Use the receiver to check that at these two points the stage is operating at 13.5 and 27 Mc/s respectively.

Connect the meter between the grid of V10 and chassis in series with a ½-MΩ resistor. Set the RANGE MC/S switch to 27 - 54 and adjust C66 and the spacing of the turns on L18 at 54 and 27 Mc/s respectively for maximum deflection on the meter. Use the receiver to check that at these two points the stage is operating at 54 and 27 Mc/s respectively.

Connect the meter and ½-MΩ resistor between the grid of V12 and chassis. Set the RANGE MC/S switch to 54 - 108 and adjust C76 and the turns spacing on L22 at 108 and 54 Mc/s respectively. Use the receiver to check that at these two points the stage is operating at 108 and 54 Mc/s respectively. Remove the meter and resistor.

4.6.6. (Continued)

Set the RANGE MC/S switch to 108 - 216, adjust C83 and the coil turns spacing on L23 for maximum reading on the TF 995A/1 output meter at 216 and 108 Mc/s respectively. Use the receiver to check that at these two points the stage is operating at 216 and 108 Mc/s respectively.

4.6.7. 2 - 13.5 Mc/s Range (Apparatus required:- Item f)

Set the RANGE MC/S switch to 2 - 13.5; adjust the TUNE control to bring the 30 Mc/s Main Dial marking to the cursor and, using the crystal calibrator, tune for zero beat. With the SET CARRIER control in its fully clockwise position adjust C40 and then C59 to give minimum deflection on the panel meter. Next, tune the receiver to some convenient accurately-known frequency between 2 and 13.5 Mc/s; then set the tuning dial of the TF 995A/1 to this frequency and, having connected the TF 995A/1 to the receiver input, adjust C40 for maximum receiver response.

In the absence of any other frequency standard, the receiver tuning may be standardized at any frequency between 4.5 and 9 Mc/s by loosely coupling its input to the basic variable oscillator of the TF 995A/1. The latter should be first standardized against the internal crystal calibrator, the basic oscillator frequency being given by dividing by three the indication on the 13.5- to 27-Mc/s scale.

4.6.8. Accuracy of the R.F. Output Voltage (Apparatus required:- Items d, e, and f)

Using a receiver as indicator, compare the c.w. output voltage with that of a Standard Signal Generator. If a constant error exists, select a new value for R70. With the instrument completely assembled in its case, the output level should be within the limits 0.89 to 1.12 of nominal up to 100 Mc/s and 0.795 to 1.25 of nominal up to 216 Mc/s, at the following frequencies and levels: 25 Mc/s, 100 Mc/s and 200 Mc/s; 100 mV and 10 μV.

4.6.9. Modulation Oscillator (Apparatus required:- Items e, i, and j)

Set the MOD SELECTOR switch to INT MOD - A.M., connect the output from the SET MOD potentiometer to the Y plates of a C.R.O. and the output from a Beat Frequency Oscillator to the X plates.

4.6.9. (Continued)

Check the frequency of oscillation by the Lissajous method and if outside the limits 950 to 1050 c/s, pad, or select a new value, for the tuning capacitor C6. The harmonic content should not be more than 1%.

Measure the sync voltage at the SYNC terminal with a Valve Voltmeter. This should be at least 100 volts.

4.6.10. Frequency Deviation (Apparatus required:- Item k)

Set the DEVIATION - NORMAL/HIGH switch to NORMAL, the DEVIATION RANGE switch to 75 kc/s, the MOD SELECTOR switch to INT MOD - F.M., the RANGE MC/S switch to 13.5 - 27, and adjust the SET CARRIER control to give a convenient deflection on the TF 995A/1 output meter. Set the OUTPUT VOLTAGE and MULTIPLY BY attenuator controls to 100 dB, connect the output cable directly to a Deviation Meter, and tune both instruments to 13.5 Mc/s.

Adjust the SET MOD control to about four-fifths of its clockwise travel and uncouple the potentiometer, R7, from the tuning capacitor gang. Set both R7 and the tuning gang to their mid-travel points and re-couple. Select or pad the series resistors, R6 and R8, to obtain 75 kc/s deviation at 13.5 Mc/s; check that this deviation is maintained at 27 Mc/s. If not, make slight adjustments to both the position of R7 rotor relative to the tuning gang, and to the values of the series resistors R6 and R8 as necessary to obtain equal deviations at 13.5 and 27 Mc/s. Care should be taken to ensure that R7 does not reach the limit of its rotation before the tuning gang.

Measure the values of the resistors, R6, R7, and R8 and let their sum be termed R_T. Select values for the resistors R13 and R14, equal to R_T and $2R_T$ respectively, in order to obtain 75 kc/s deviation at 27 Mc/s on the 27 - 54 Mc/s band, check that this deviation is maintained at 54 Mc/s.

Select a value for R11 equal to $3R_T$ and a value for R9 equal to $1.3\ R_T$, in order that 75 kc/s deviation may be obtained at 54 and 108 Mc/s, on the 54 - 108 Mc/s band.

Select values for R5 and R12, equal to $7R_T$ and $1.2R_T$ respectively, so that 75 kc/s deviation is obtained at both 108 and 216 Mc/s, on the 108 - 216 Mc/s band.

4.6.10. (Continued)

If a Deviation Meter is not available, then the following method may be used to determine the frequency deviation. This method, the "disappearing carrier" method, depends upon the fact that the carrier - as opposed, of course, to the side-bands - disappears when the modulation index μ (the ratio of the frequency deviation δF to the modulation frequency f) has values of 2.4, 5.52, 8.65, 11.79, etc. Therefore, the deviation $\delta F = \mu f$; for example, if the applied modulation has a frequency of 10 kc/s and the deviation is progressively increased until the carrier disappears, the deviation must be $2.4 \times 10 = 24$ kc/s, and again, $5.52 \times 10 = 55.2$ kc/s.

A deviation check at 75 kc/s can be obtained at the second "carrier disappearance" with a modulation frequency of 13.6 kc/s.

To determine these points, apply the output of the TF 995A/1 to a narrow band (communication) a.m. receiver and tune the latter to the unmodulated output frequency of the TF 995A/1. Set the beat oscillator of the receiver to give an audio note, then frequency-modulate the signal at a fairly high frequency outside the pass-band of the a.m. receiver, such as 10 kc/s, starting from zero deviation and increasing the deviation until the beat with the carrier disappears. At this point the actual deviation can be calculated as described above.

4.6.11. F.M. Distortion (Apparatus required:- Items c, and k)

Set the DEVIATION - NORMAL/HIGH switch to NORMAL, the DEVIATION RANGE switch to 75 kc/s, the MOD SELECTOR switch to INT MOD - F.M., the RANGE MC/S switch to 13.5 - 27, and adjust the SET CARRIER control to give a convenient deflection on the TF 995A/1 panel meter. Set the OUTPUT VOLTAGE and MULTIPLY BY attenuators to 100 dB, connect the output cable directly to a Deviation Meter, and tune both instruments to 20 Mc/s.

Adjust the SET MOD control to produce 75 kc/s deviation. Select a value for R19 which will produce equal positive and negative deviations as measured on the Deviation Meter.

Apply the demodulated f.m. signal from the Deviation Meter to a Wave Analyser and measure the distortion at 13.5, 27, 90, and 216 Mc/s. The total f.m. distortion should not exceed 2%.

.6.12. Deviation Range Adjustments (Apparatus required:- Item k)

Set the DEVIATION - NORMAL/HIGH switch to NORMAL, the DEVIATION RANGE switch to 75 kc/s, the MOD SELECTOR switch to INT MOD - F.M., and adjust the SET CARRIER control to bring the meter pointer to SET R.F. Set the OUTPUT VOLTAGE and MULTIPLY BY attenuators to 100 dB, connect the output cable directly to a Deviation Meter, and tune both instruments to the same frequency.

Adjust the SET MOD control to maximum and select a value for R2 which will produce a deviation of approximately 85 kc/s, as measured on the Deviation Meter.

Set the DEVIATION RANGE switch to 25 kc/s and select a value for R24 so that a deviation of approximately 28 kc/s is obtained with the SET MOD control at its maximum position.

.6.13. Deviation Monitor Circuit (Apparatus required:- Item k)

Check the accuracy of the deviation reading on the TF 995A/1 meter using a Deviation Meter or the "disappearing carrier" method described in a preceding section. If the indication of the TF 995A/1 is not accurate, adjust R65. If adjustment of R65 does not correct the error on both ranges, proceed as follows.

Turn the SET MOD control to zero, the preset control R65 to mid-travel, set the DEVIATION RANGE switch to 25 kc/s and hold the METER READS switch to F.M. Select R69 to give zero reading on the TF 995A/1 meter.

Set the METER READS switch to C.W. and rotate the SET MOD control until 25 kc/s deviation is indicated on the Deviation Meter. Hold the METER READS switch to F.M. and select R67 so that the TF 995A/1 meter indicates the 25 kc/s deviation.

Set the DEVIATION RANGE switch to 75 kc/s, the METER READS switch to C.W., rotate the SET MOD control to zero, and hold the METER READS switch to F.M. Select R68 to give zero reading on the TF 995A/1 meter. Return the METER READS switch to C.W., and rotate the SET MOD control until 75 kc/s deviation is indicated on the Deviation Meter. Hold the METER READS switch to F.M. and select R66 to give full scale reading on the TF 995A/1 meter.

Finally, re-check the deviation calibration at several points on each band.

4.6.14. High Deviation (Apparatus required:- Item k)

Connect the output of the TF 995A/1 to a Deviation Meter and check that when the TF 995A/1 is set for 9 kc/s deviation with the DEVIATION - NORMAL/HIGH switch set to NORMAL, the deviation, indicated on the Deviation Meter, rises to approximately the following values when the DEVIATION - NORMAL/HIGH switch is set to HIGH.

RANGE Mc/s	2-13.5	13.5-27	27-54	54-108	108-216
HIGH Deviation for 9 kc/s NORMAL	18 kc/s	9 kc/s	18 kc/s	36 kc/s	72 kc/s

4.6.15. External F.M. (Apparatus required:- Items i, and k)

Connect the output of a Beat Frequency Oscillator to the EXT MOD and E terminals and set it to deliver 30 volts r.m.s. at 1 kc/s. Set the MOD SELECTOR switch to EXT MOD - F.M., the DEVIATION - NORMAL/HIGH switch to NORMAL, hold the METER READS switch to F.M., and adjust the SET MOD control for 75 kc/s deviation. Tune the Beat Frequency Oscillator over the range 50 c/s to 15 kc/s and check that the input required for 75 kc/s deviation does not vary by much more than ±1 dB.

Feed the output of the TF 995A/1 to the Deviation Meter and repeat the operation using the Deviation Meter as indicator; check that not more than ±1 dB variation in input is required to maintain the deviation at 75 kc/s.

4.6.16. Internal A.M. (Apparatus required:- Items c, f, and j)

Apply the output of the TF 995A/1 to a frequency changer circuit which is followed by an i.f. amplifier and Cathode Ray Oscilloscope; the i.f. amplifier should have a centre frequency which will allow its output to be viewed directly on the C.R.O. Set the MOD SELECTOR switch to INT MOD - A.M. and adjust the SET MOD control for 30% modulation as measured on the C.R.O. screen using the formula:-

$$M(\%) = \frac{D\ max - D\ min}{D\ max + D\ min} \times 100$$

4.6.16. (Continued)

where

D max = the peak-to-peak dimensions of the C.R.O. display.

D min = the trough-to-trough dimensions of the C.R.O. display.

Hold the METER READS switch to A.M. and check that the meter reading is correct. If not, select a new value for R63.

Using the Wave Analyser check that the total distortion of the detected output appearing across R70 does not, in general, exceed 5% at 30% modulation.

4.6.17. External A.M. (Apparatus required:- Items f, i, and j)

Connect the output of a Beat Frequency Oscillator to the EXT MOD and E terminals, and adjust it to produce approximately 30 volts r.m.s. Set the MOD SELECTOR switch to EXT MOD - A.M. and adjust the SET CARRIER control so that the meter reads SET R.F. Adjust the SET MOD control to produce 30% modulation depth at 1000 c/s, as measured on an oscilloscope in the manner outlined in Section 4.6.16. Tune the Beat Frequency Oscillator from 50 c/s to 10 kc/s and check that the input required to produce 30% modulation is flat within 1 dB relative to 1000 c/s. If not, select a value for R39 which fulfils these conditions.

4.6.18. Spurious A.M. (Apparatus required:- Item e)

Set the TF 995A/1 for 10% a.m. at 20 Mc/s and measure the a.c. voltage appearing across R70. Set to 75 kc/s deviation and check that the voltage across R70 is not greater than before.

APPENDICES

VALVE REPLACEMENT DATA.....VRD 995A/1: Two Sheets

COMPONENT LAYOUT ILLUSTRATIONS
Front Panel.....MP 995A/1-1
General Underside View from Rear (Case Removed).....MP 995A/1-2
L.F. and R.F. Units (Top View with R.F.Unit Screening Cover Removed).....MP 995A/1-3
R.F. Unit (General Underside View).....MP 995A/1-
R.F. Unit (Close-up of Portion of Underside).....MP 995A/1-5
L.F. Unit (Underside View).....MP 995A/1-6
Attenuators (Covers Removed).....MP 995A/1-7
Power Unit.....MP 995A/1-8

SPARES ORDERING SCHEDULE WITH CIRCUIT REFERENCES.....SOS/995A/1: Twenty-one Sheets

BLOCK SCHEMATIC DIAGRAM..... ...TBX 23556: Printed Version

COMPLETE CIRCUIT DIAGRAM.....TDX 23080: Printed Version

DECIBEL CONVERSION TABLE.....EB G-SUPP DB: Two Sheets

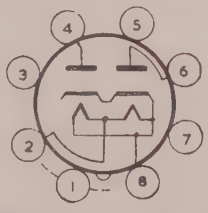
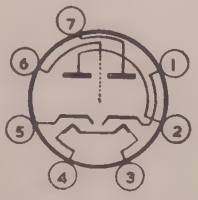
VALVE REPLACEMENT DATA

FOR

F.M./A.M. SIGNAL GENERATOR Type TF 995A/1

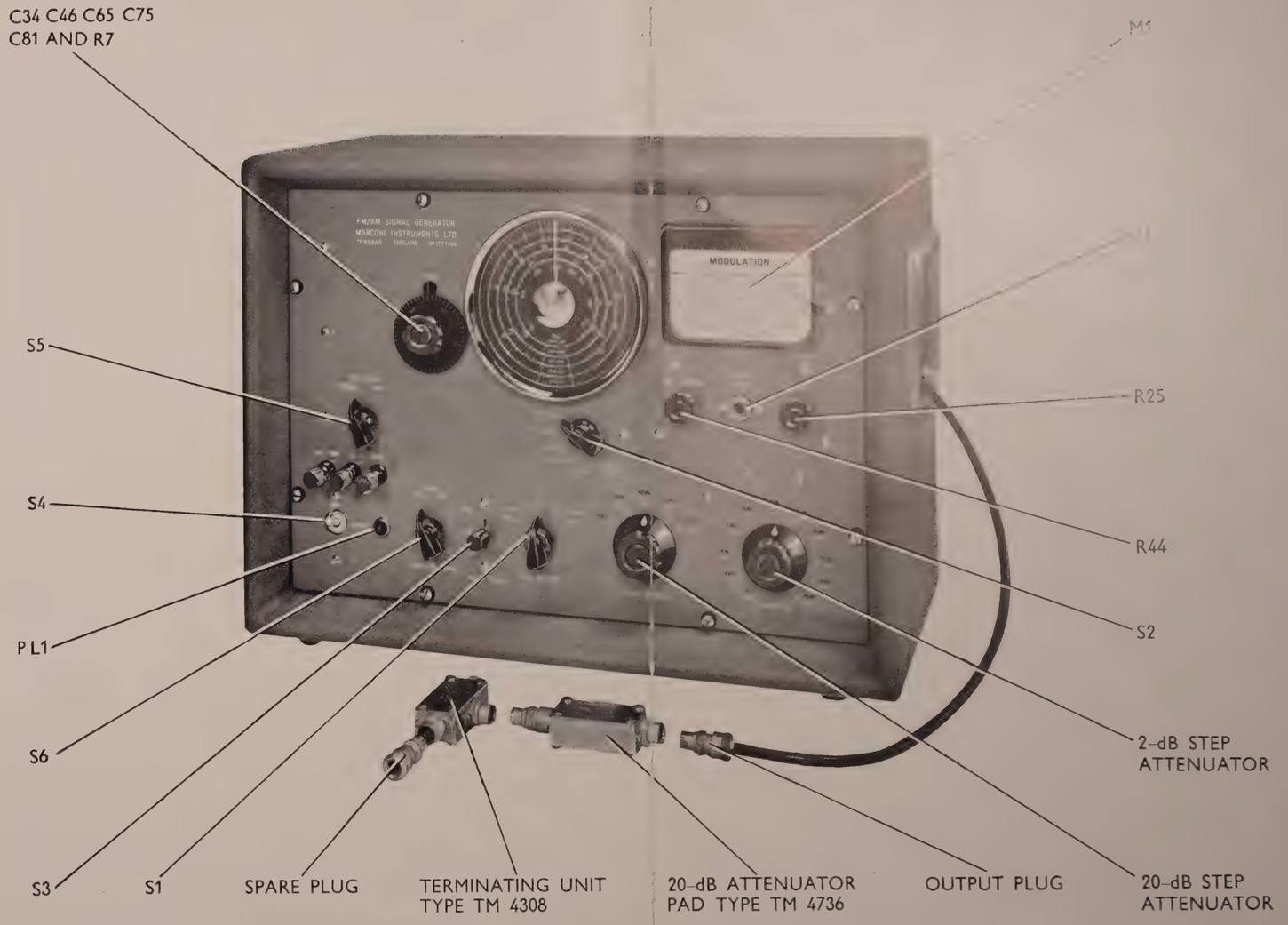
Any valve which becomes faulty should preferably be replaced by a valve of the type originally supplied in the instrument and designated in the following table. If this is not possible, the additional data given by the table may be used as a guide to suitable alternatives.

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V1, V2 POWER PENTODE BRIMAR 6AK6		CV1762	MINIATURE 7-PIN (B7G)	6AK6
V3, V4, V6, V8, V10, V12 H.F. PENTODE MULLARD EF95	6AK5	CV850	MINIATURE 7-PIN (B7G)	6AK5
V5 PENTODE BRIMAR 6AU6		CV2524 CV4023	MINIATURE 7-PIN (B7G)	6AU6

Valve	*British Commercial Equivalent*	*British Services Equivalent*	*Base*	*U.S. Equivalent*
V7 DOUBLE TRIODE BRIMAR 12AT7	ECC81	CV455	MINIATURE 9-PIN (B9A) 	12AT7
V9 VOLTAGE STABILIZER MARCONI QS150/15	QS1200* OA2*	CV287 CV1832* CV4020*	MINIATURE 7-PIN (B7G) 	OA2*
V11 FULL-WAVE RECTIFIER BRIMAR 5Z4G	R52 GZ30 52KU U50	CV1863	INTERNATIONAL OCTAL 	5Z4G
V13 DOUBLE DIODE MARCONI D77	6AL5 6D2 D152 DD6 EB91	CV140	MINIATURE 7-PIN (B7G) 	6AL5

*The base connections for these voltage stabilizers are different from those of the type QS150/15 (CV287). The holder for V9 in the TF 995A/1 has been specially wired so that, without rewiring, any of the voltage stabilizers listed on this sheet can be used.

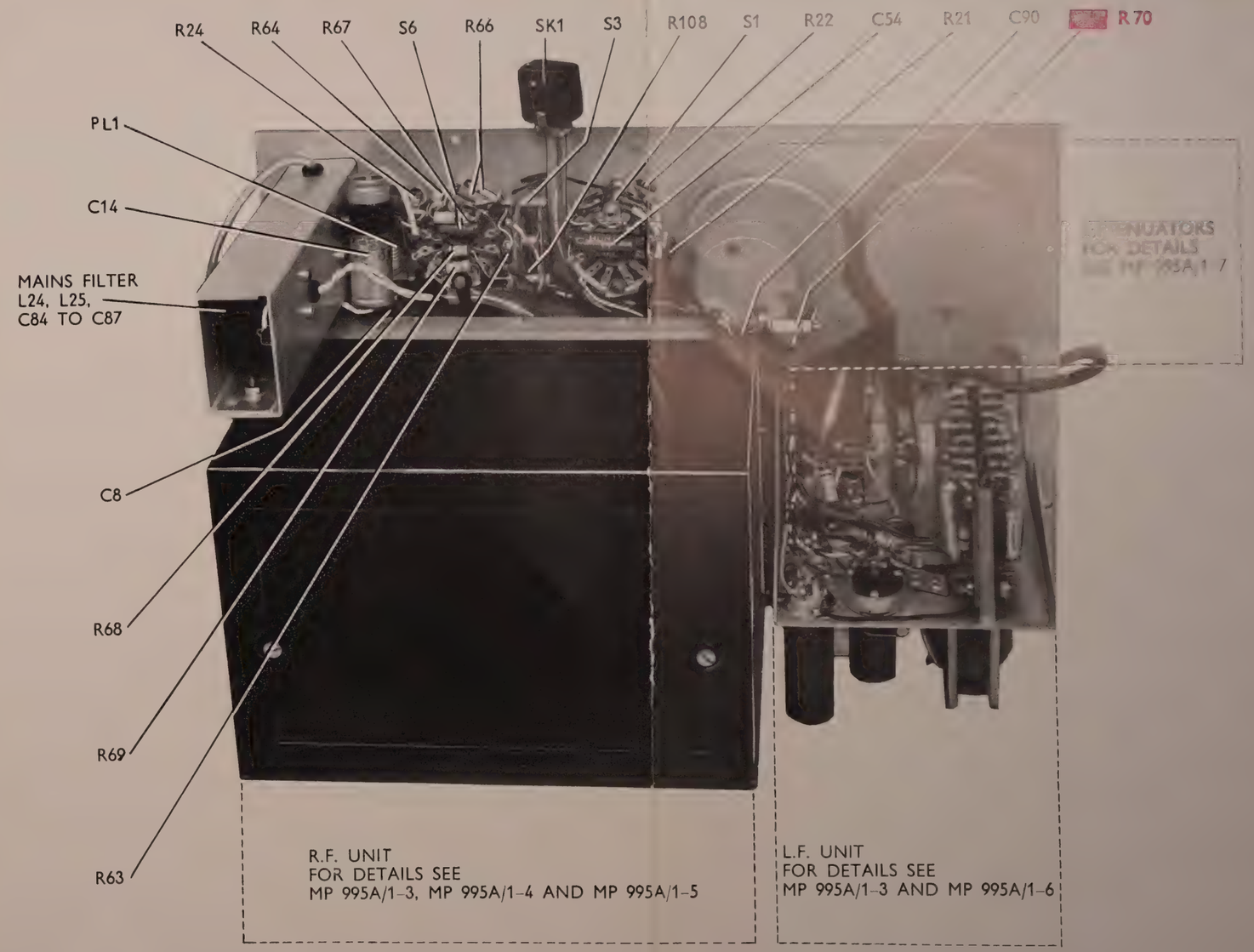
FRONT PANEL



FRONT PANEL

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-1	

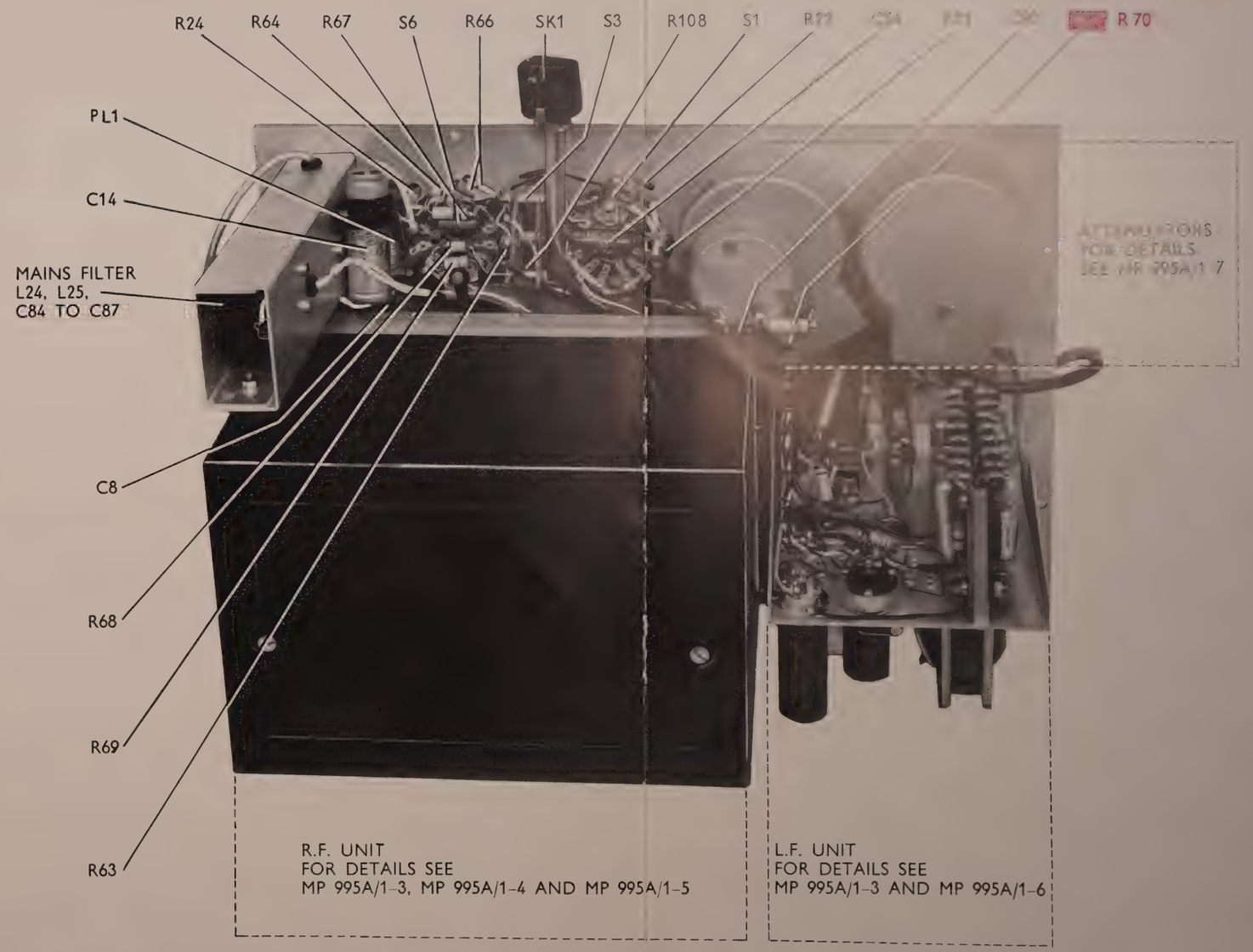
GENERAL
UNDERSIDE VIEW
FROM REAR
(CASE REMOVED)



GENERAL UNDERSIDE VIEW FROM REAR (CASE REMOVED)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP995A/1–2	

GENERAL
UNDERSIDE VIEW
FROM REAR
(CASE REMOVED)

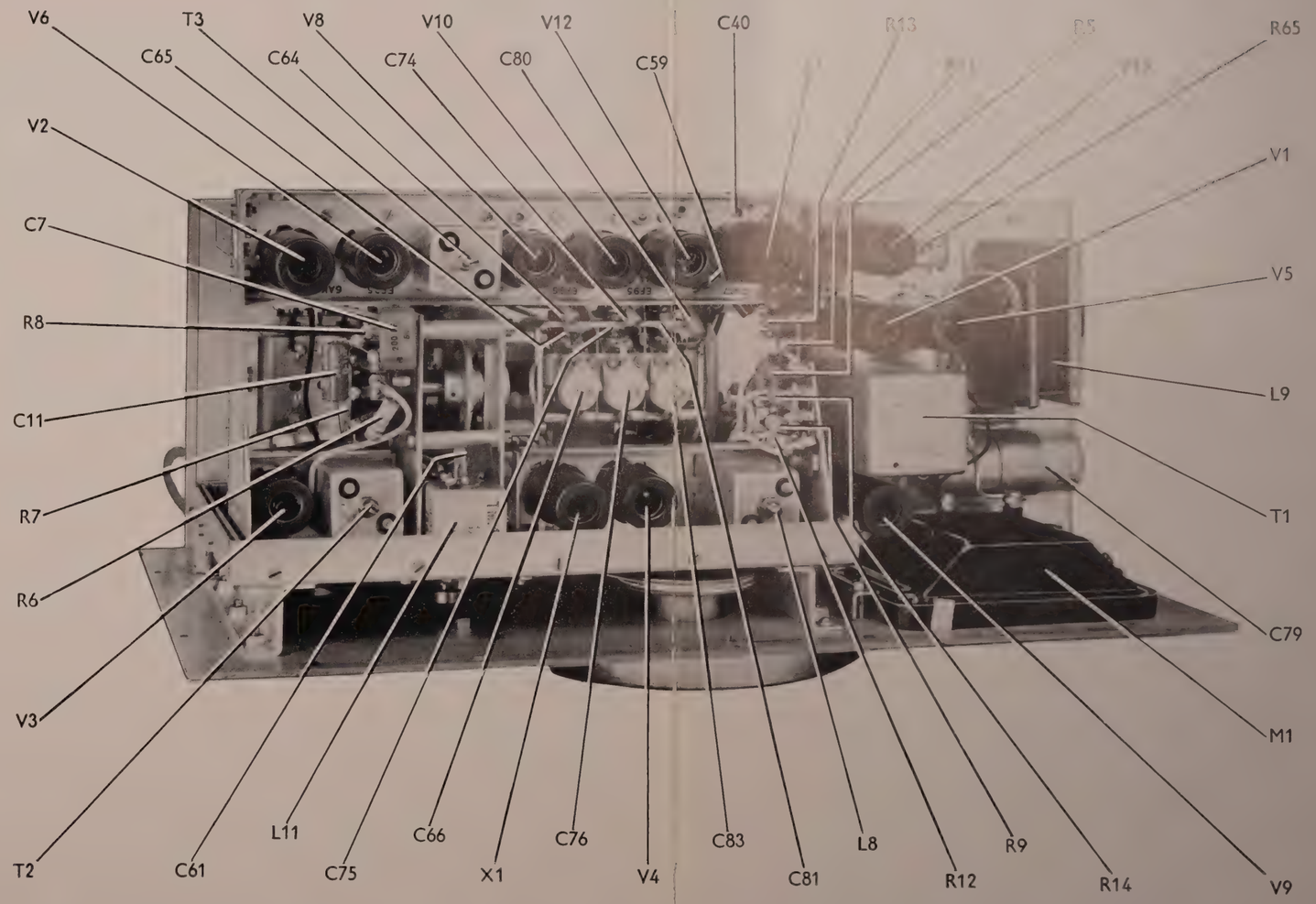


GENERAL UNDERSIDE VIEW FROM REAR (CASE REMOVED)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP995A/1-2	

L.F. AND R.F. UNITS

(TOP VIEW WITH R.F. UNIT SCREENING COVER REMOVED)

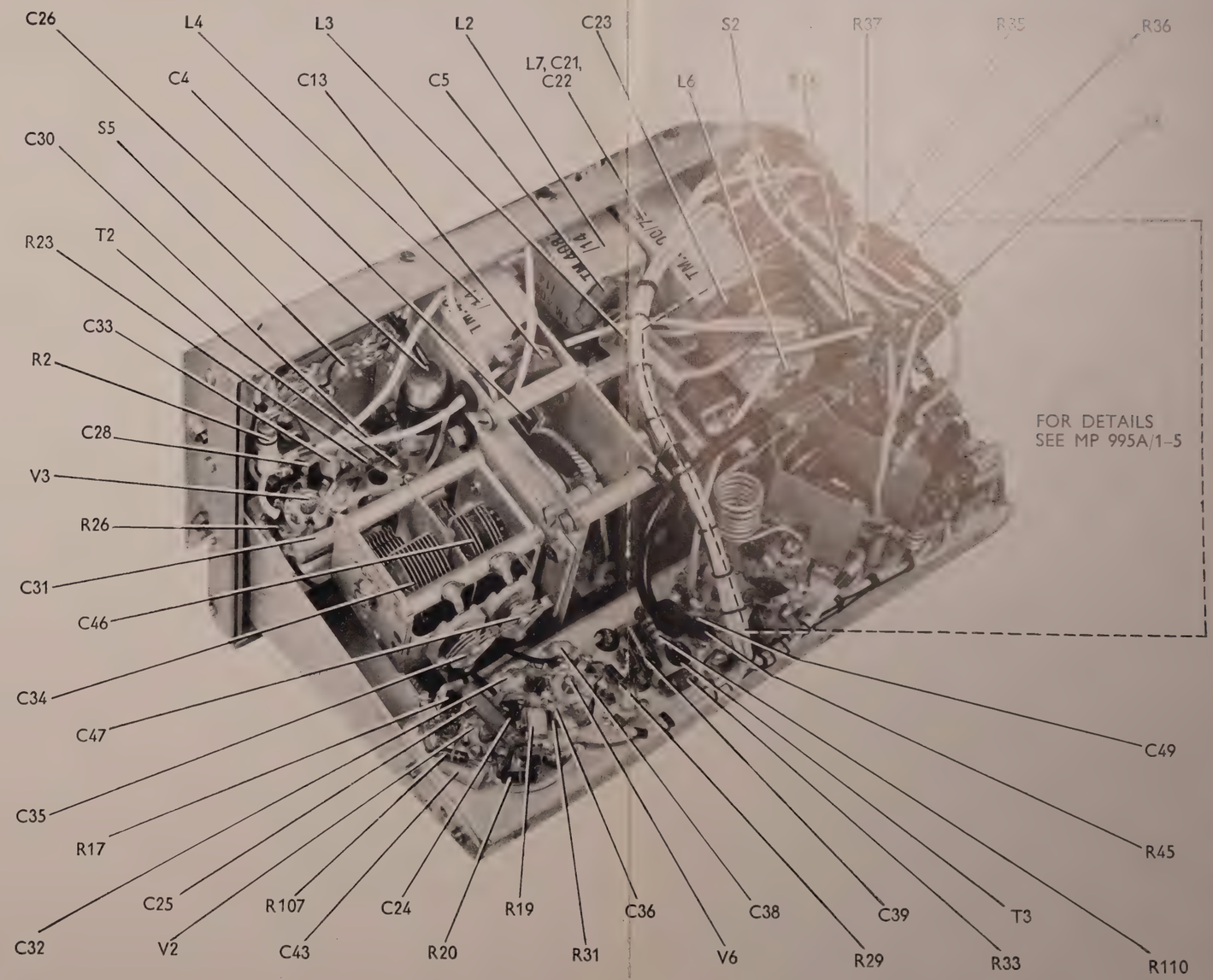


L.F. AND R.F. UNITS (TOP VIEW WITH R.F. UNIT SCREENING COVER REMOVED)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-3	

R.F. UNIT

(GENERAL UNDERSIDE VIEW)

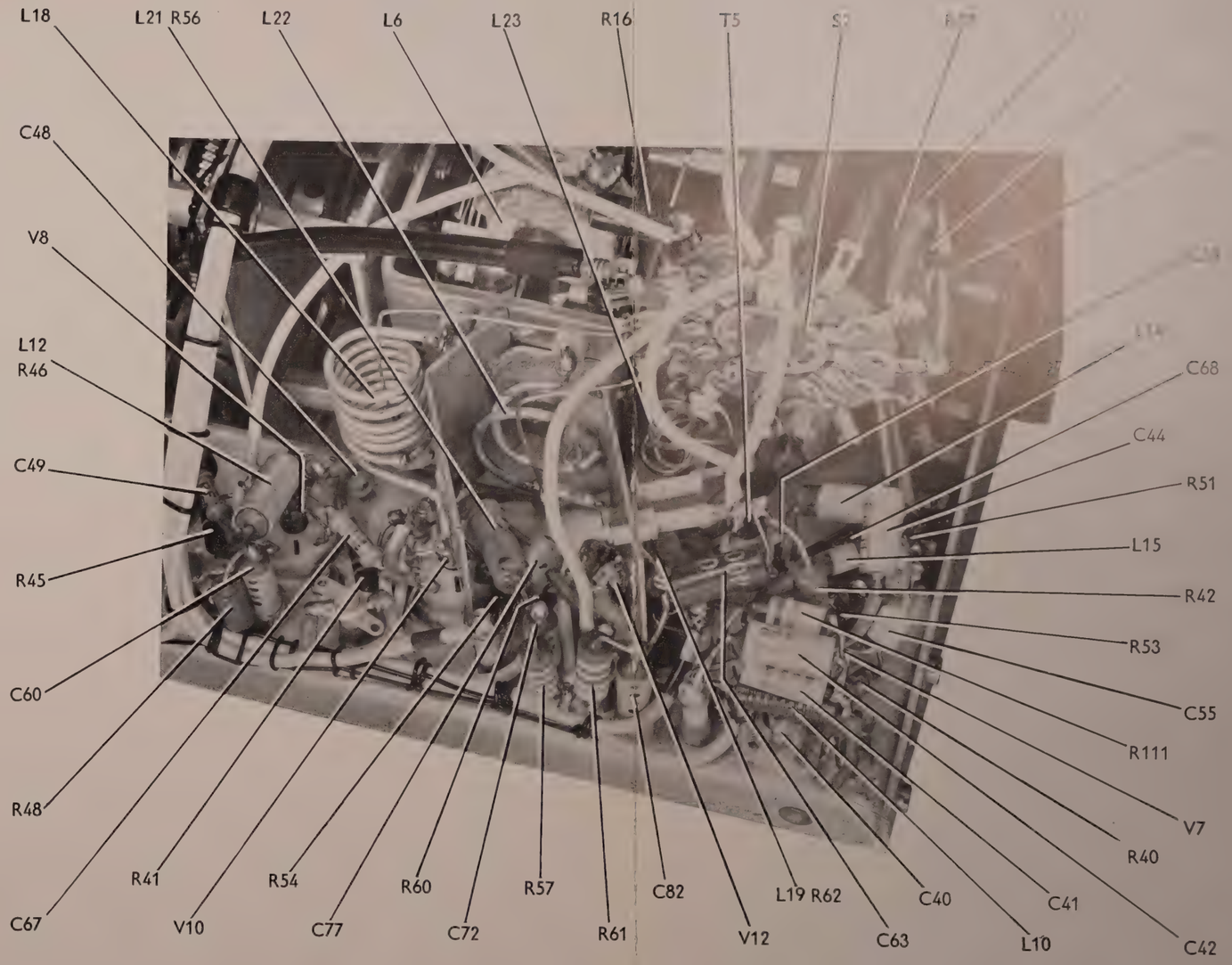


R.F. UNIT (GENERAL UNDERSIDE VIEW)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-4	

R.F. UNIT

(CLOSE UP OF PORTION OF UNDERSIDE)



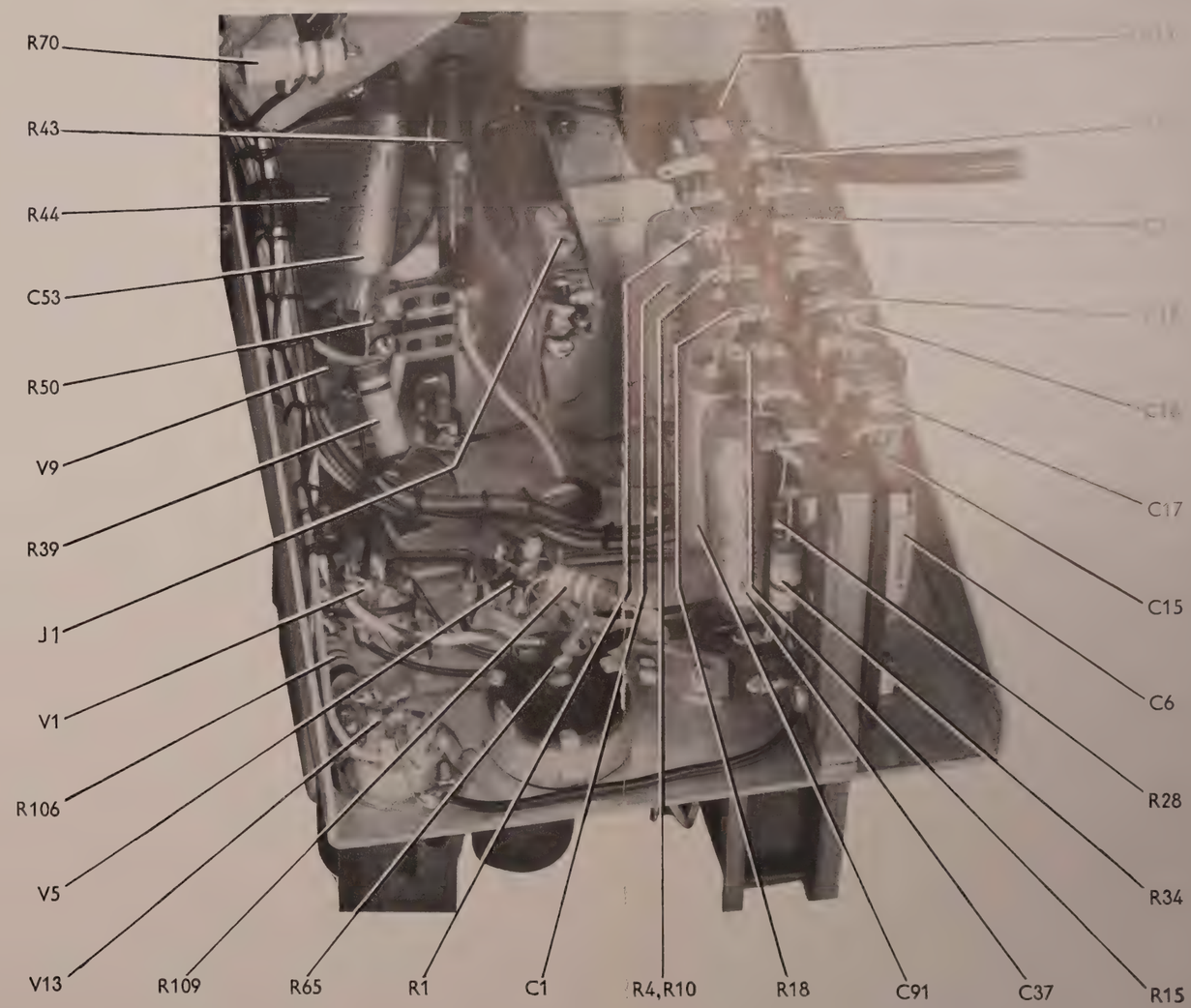
R.F. UNIT (CLOSE UP OF PORTION OF UNDERSIDE)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-5	

L.F. UNIT

(UNDERSIDE VIEW)

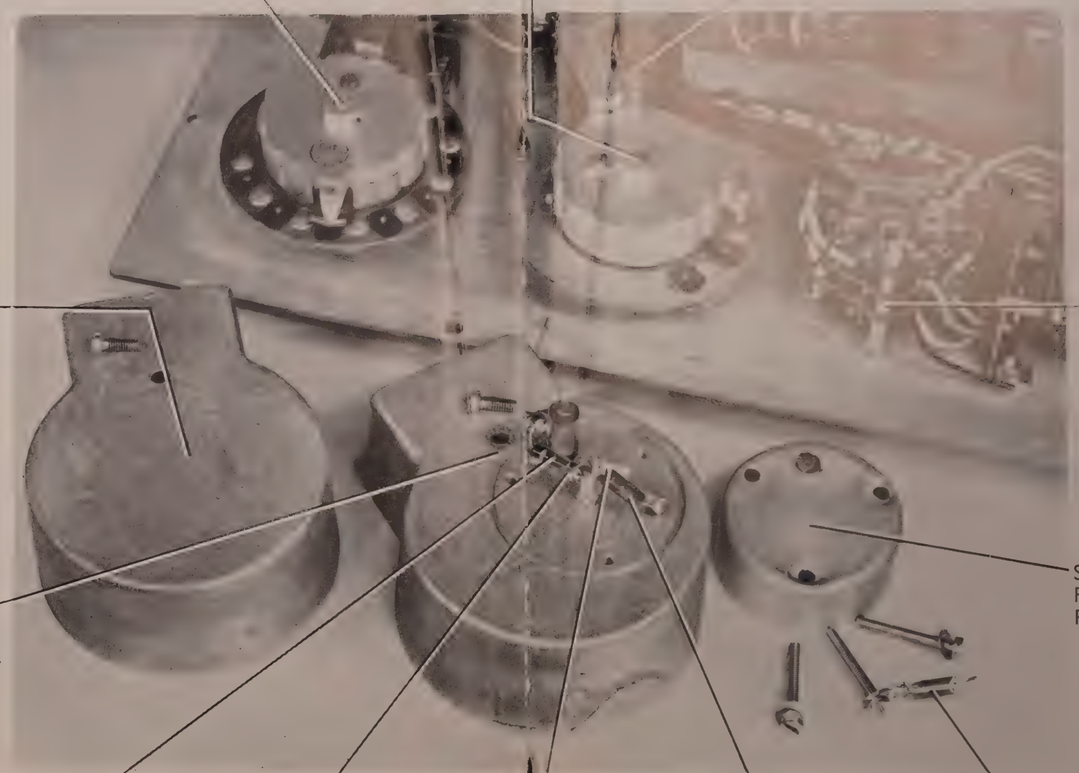
MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-6	



L.F. UNIT (UNDERSIDE VIEW)

ATTENUATORS

(COVERS REMOVED)



ATTENUATORS (COVERS REMOVED)

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-7	

SPARES ORDERING SCHEDULE NO. SOS/995A/1, ISSUE 1

WITH CIRCUIT REFERENCES

for

F.M./A.M. SIGNAL GENERATOR TYPE TF 995A/1

Applicable to Instruments,
Serial Nos.:-
1777176 to 1777200
1824001 to 1824300

When ordering replacement parts, please state: the quantity and type required, the number and issue of this Spares Ordering Schedule, and the SOS item number of the part required.

For example, to order a replacement for the 220-kΩ, $\frac{1}{2}$-watt resistor, R3, quote:-

1 off, Resistor: SOS/995A/1, Issue 1, Item 3.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS	
1	R1	Composition, 470 kΩ ± 20%, 1/4 W.	4-TM4800
2	R2	Composition, 1.5 kΩ*, 1/2 W.	58-TM4826
3	R3	Composition, 220 kΩ ± 20%, 1/2 W.	18-TM4800
4	R4	Composition, 270 kΩ ± 20%, 1/8 W.	5-TM4800
5	R5	Composition, 27 kΩ*, 1/4 W.	5-TM4706
6	R6	Composition, 2.7 kΩ*, 1/2 W.	59-TM4826

* Nominal value; actual value determined during calibration.

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
27	R27	Composition, 2.7 kΩ ± 20%, 1/8 W.	52-TM4826
28	R28	Composition, 220 kΩ ± 20%, 1/8 W.	10-TM4800
29	R29	Composition, 6.8 kΩ ± 20%, 1/8 W.	65-TM4826
30	R30	Composition, 6.8 kΩ ± 20%, 1/4 W.	114-TM4826
31	R31	Composition, 270 kΩ ± 20%, 1/8 W.	51-TM4826
32	R32	Composition, 100 Ω ± 20%, 1/4 W.	54-TM4826
33	R33	Composition, 2.2 kΩ ± 20%, 1/4 W.	66-TM4826
34	R34	Composition, 390 Ω ± 5%, 1/4 W.	11-TM4800
35	R35	Wire-Wound, 15 kΩ ± 5%, 7 W.	112-TM4826
36	R36	Wire-Wound, 7.5 kΩ ± 5%, 7 W.	111-TM4826
37	R37	Wire-Wound, 5 kΩ ± 5%, 7 W.	110-TM4826
38	R39	Composition, 220 kΩ*, 1/2 W.	110-TF9954/1
39	R40	Composition, 15 kΩ ± 20%, 1/8 W.	64-TM4826
40	R41	Composition, 6.8 kΩ ± 20%, 1/8 W.	65-TM4826
41	R42	Composition, 2.2 kΩ ± 20%, 1/4 W.	66-TM4826
42	R43	Composition, 10 kΩ ± 20%, 1 W.	61-TF9954/1
43	R44	Wire-Wound, 20 kΩ Variable, ± 10%, 3 W.	75-TF9954/1
44	R45	Composition, 100 kΩ ± 20%, 1/8 W.	50-TM4826
45	R46	Composition, 6.8 kΩ ± 20%, 1/2 W; includes L12.	TB23173/8
46	R47	Composition, 10 kΩ ± 20%, 1/2 W.	5-TM4087/10

* Nominal value; actual value determined during calibration

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
67	R68	Composition, 150 kΩ*, 1/4 W.	62-TF995A/1
68	R69	Composition, 47 kΩ*, 1/4 W.	60-TF995A/1
69	R70	Composition, 2.7 kΩ*, 1/8 W.	71-TF995A/1
70	R71	Composition, 1 kΩ ± 20%, 1/8 W.	41-TM4297
71	R72	Composition, 1 kΩ ± 20%, 1/8W.	41-TM4297
72	R73	Carbon, High Stability, 82.5 kΩ ± 1%, 1/8 W.	36-TM4297
73	R74	Carbon, High Stability, 742 Ω ± 1%, 1/8 W.	35-TM4297
74	R75	Carbon, High Stability, 742 Ω ± 1%, 1/8 W.	35-TM4297
75	R76	Carbon, High Stability, 742 Ω ± 1%, 1/8 W.	35-TM4297
76	R77	Carbon, High Stability, 742 Ω ± 1%, 1/8 W.	35-TM4297
77	R78	Carbon, High Stability, 220 Ω ± 1%, 1/8 W.	38-TM4297
78	R79	Carbon, High Stability, 91.6 Ω ± 1%, 1/8 W.	37-TM4297
79	R80	Carbon, High Stability, 91.6 Ω ± 1%, 1/8 W.	37-TM4297
80	R81	Carbon, High Stability, 91.6 Ω ± 1%, 1/8 W.	37-TM4297
81	R82	Carbon, High Stability, 82.5 Ω ± 1%, 1/8 W.	36-TM4297
82	R83	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
83	R84	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
84	R85	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
85	R86	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
86	R87	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298

* Nominal value; actual value determined during calibration

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
87	R88	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
88	R89	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
89	R90	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
90	R91	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
91	R92	Carbon, High Stability, 17.9 Ω ± 1%, 1/8 W.	24-TM4298
92	R93	Carbon, High Stability, 61.2 Ω ± 1%, 1/8 W.	28-TM4298
93	R94	Carbon, High Stability, 332 Ω ± 1%, 1/8 W.	26-TM4298
94	R95	Carbon, High Stability, 167 Ω ± 1%, 1/8 W.	27-TM4298
95	R96	Carbon, High Stability, 167 Ω ± 1%, 1/8 W.	27-TM4298
96	R97	Carbon, High Stability, 167 Ω ± 1%, 1/8 W.	27-TM4298
97	R98	Carbon, High Stability, 167 Ω ± 1%, 1/8 W.	27-TM4298
98	R99	Carbon, High Stability, 37.5 Ω ± 1%, 1/8 W.	25-TM4298
99	R100	Carbon, High Stability, 90 Ω ± 2%, 1/8 W.	12-TM4736
100	R101	Carbon, High Stability, 90 Ω ± 2%, 1/8 W.	12-TM4736
101	R102	Carbon, High Stability, 360 Ω ± 1%, 1/8 W.	13-TM4736
102	R103	Carbon, High Stability, 37.5 Ω ± 5%, 1/8 W.	10-TM4308
103	R104	Carbon, High Stability, 75 Ω ± 5%, 1/8 W.	11-TM4308
104	R105	Carbon, High Stability, 14.5 Ω ± 5%, 1/8 W.	12-TM4308
105	R106	Composition, 560 Ω ± 10%, 1/4 W.	77-TF995A/1
106	R107	Composition, 22 kΩ ± 20%, 1/8 W.	69-TM4826
107	R108	Composition, 1 MΩ ± 20%, 1/4 W.	59-TF995A/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		RESISTORS (continued)	
108	R109	Composition, 2.2 kΩ ± 10%, 1/8 W.	69-TF995A/1
109	R110	Composition, 100 Ω ± 20%, 1/4 W.	54-TM4826
110	R111	Composition, 10 kΩ ± 20%, 1/4 W.	57-TM4826
		CAPACITORS	
111	C1	Paper, 0.1 µF ± 20%, 350 V d.c.	3-TM4800
112	C2	Paper, 0.1 µF ± 20%, 350 V d.c.	17-TM4800
113	C3	Mica, Special Assembly, 100 µµF, Nominal.	
114	C4	Mica, 100 µµF ± 10%, 350 V d.c.	117-TM4826
115	C5	Mica, 100 µµF ± 10%, 350 V d.c.	117-TM4826
116	C6	Paper, 0.02 µF*, 350 V d.c.	12-TM4800
117	C7	Mica, 200 µµF ± 20%, 350 V d.c.	71-TM4826
118	C8	Mica, 100 µµF ± 10%, 350 V d.c.	95-TF995A/1
119	C9	Mica, 100 µµF ± 20%, 350 V d.c.	86-TF995A/1
120	C10	Mica, Special Assembly, 100 µµF, Nominal.	

* Nominal value; actual value determined during calibration

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
121	C11	Paper, 0.1 µF ± 25%, 150 V d.c.	90-TM4826
122	C12	Mica, Special Assembly, 100 µµF, Nominal.	
123	C13	Mica, 100 µµF ± 10%, 350 V d.c.	117-TM4826
124	C14	Paper, 2 µF ± 25%, 250 V d.c.	87-TF995A/1
125	C15	Paper, 0.01 µF ± 20%, 350 V d.c.	13-TM4800
126	C16	Paper, 0.01 µF ± 25%, 350 V d.c.	15-TM4800
127	C17	Paper, 0.1 µF ± 20%, 350 V d.c.	14-TM4800
128	C18	Paper, 0.1 µF ± 20%, 350 V d.c.	16-TM4800
129	C19	Mica, Special Assembly, 100 µµF, Nominal.	
130	C20	Ceramic, 0.01 µF - 20% + 100%.	135-TM4826
131	C21	Ceramic, 0.001 µF ± 20%, 400 V d.c. Included in Item 195.	12-TM3900/75
132	C22	Mica, Special Assembly, 100 µµF, Nominal. Included in Item 195.	
133	C23	Mica, 100 µµF ± 20%, 350 V d.c.	86-TM4826
134	C24	Paper, 0.001 µF ± 20%, 350 V d.c.	91-TM4826
135	C25	Mica, 39 µµF ± 5%, 350 V d.c.	85-TM4826
136	C26	Paper, 0.1 µF ± 20%, 350 V d.c.	78-TM4826
137	C27	Paper, 0.001 µF ± 20%, 350 V d.c.	91-TM4826
138	C28	Paper, 0.01 µF ± 20%, 350 V d.c.	83-TM4826
139	C29	Mica, 47 µµF ± 20%, 350 V d.c. Included in Item 196.	9-TM3900/74

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
156	C50	Ceramic, 47 µµF ± 20%, 500 V d.c.	73-TM4826
157	C51	Mica, 100 µµF ± 10%, 350 V d.c.	117-TM4826
158	C52	Mica, Special Assembly, 100 µµF, Nominal.	
159	C53	Electrolytic, 2 µF - 20% + 50%, 150 V d.c.	103-TF995A/1
160	C54	Paper, 0.1 µF ± 25%, 250 V d.c.	93-TF995A/1
161	C55	Ceramic, 100 µµF ± 20%, 500 V d.c.	72-TM4826
162	C56	Mica, 100 µµF ± 10%, 350 V d.c.	117-TM4826
163	C57	Mica, Special Assembly, 100 µµF, Nominal.	
164	C59	Air, Trimmer, 1.25 - 10 µµF.	116-TM4826
165	C60	Ceramic, Stand-Off, 0.001 µF ± 20%, 350 V d.c.	79-TM4826
166	C61	Ceramic, 5 µµF ± 20%, 500 V d.c.	118-TM4826
167	C62	Electrolytic, 30 µF - 20% ± 50%, 350 V d.c.	13-TM4299
168	C63	Paper, 0.01 µF ± 20%, 350 V d.c.	83-TM4826
169	C64	Ceramic, 100 µµF ± 20%, 750 V d.c.	81-TM4826
170		Three-section ganged capacitor complete with trimmers; includes C65, C66, C75, C76, C81 and C83.	TC21478/2
	C65	Air, Variable, 7 - 100 µµF; part of Item 170.	
	C66	Air, Trimmer, 2 - 8 µµF; part of Item 170.	
171	C67	Ceramic, 22 µµF ± 20%, 500 V d.c.	87-TM4826
172	C68	Paper, 0.01 µF ± 20%, 350 V d.c.	83-TM4826

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CAPACITORS (continued)	
187	C88	Ceramic, 0.001 µF ± 20%, 400 V d.c.	39-TM4297
188	C89	Paper, 0.001 µF ± 20%, 350 V d.c.	46-TM4297
189	C90	Paper, 0.001 µF ± 20%, 350 V d.c.	92-TF995A/1
		INDUCTORS	
190	L1	Screened R.F. Inductor Assembly.	TM4087/14
191	L2	Screened R.F. Inductor Assembly.	TM4087/14
192	L3	R.F. Inductor.	TB16363/27
193	L4	Screened R.F. Inductor Assembly.	TM4087/14
194		Main portion of three-section filter assembly; includes L6 and L7, and Items 131 and 132.	TM3900/75
	L6	Unscreened R.F. Inductor; part of Item 194.	
	L7	Screened R.F. Inductor Assembly; part of Item 194.	
196	L8	Screened R.F. Inductor Assembly; includes Item 139.	TM3900/74
199	L9	Modulation Choke.	TM4159/1
200	L10	30-Mc/s Oscillator Inductor.	TB23173/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		TRANSFORMERS	
216	T1	A.F. Oscillator Transformer.	TM4085/2
217	T2	Master Oscillator Transformer, 4.5 to 9 Mc/s.	TM3900/87
218	T3	Multiplier Transformer, 13.5 to 27 Mc/s.	TM3900/52
219	T4	Mains Transformer.	TM4501
220	T5	Output Transformer, 2 to 13.5 Mc/s.	TB23173/5
		SWITCHES	
221	S1	Rotary, 8 pole, 5 position, 4 wafer.	TC4428/373
222	S2	Rotary, 10 pole, 5 position, 4 wafer.	TC4428/366
223	S3	Lever-Actuated Rotary, 2 pole, 3 position, 2 wafer, biased to mid-position; includes bakelite handle.	TC4428/342
224	S4	Toggle, 2 pole, 2 position.	TA20831
225	S5	Rotary, 2 pole, 2 position, single wafer.	96-TM4826
226	S6	Rotary, 4 pole, 2 position, single active wafer, with extra dummy wafer.	TC4428/344

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, VALVE HOLDERS, and RETAINERS	
227	V1	6AK6, Pentode.	47-TF995A/1
228		Holder, for V1.	44-TF995A/1
229		Retainer, for V1.	45-TF995A/1
230	V2	6AK6, Pentode.	100-TM4826
231		Holder, for V2.	98-TM4826
232		Retainer, for V2.	99-TM4826
233	V3	EF95, Pentode.	101-TM4826
234		Holder, for V3.	98-TM4826
235		Retainer, for V3.	97-TM4826
236	V4	EF95, Pentode.	101-TM4826
237		Holder, for V4.	98-TM4826
238		Retainer, for V4.	97-TM4826
239	V5	6AU6, Pentode.	49-TF995A/1
240		Holder, for V5.	44-TF995A/1
241		Retainer, for V5	45-TF995A/1
242	V6	EF95, Pentode.	101-TM4826
243		Holder, for V6.	98-TM4826
244		Retainer, for V6.	97-TM4826
245	V7	12AT7, Double Triode.	103-TM4826
246		Holder, for V7.	105-TM4826
247		Retainer, for V7.	94-TM4826

SOS Item No.	Circuit Ref.	Description	Works Ref.
		VALVES, VALVE HOLDERS, and RETAINERS (continued)	
248	V8	EF95, Pentode.	101-TM4826
249		Holder, for V8.	98-TM4826
250		Retainer, for V8.	97-TM4826
251	V9	QS150/15, Voltage Stabilizer.	48-TF995A/1
252		Holder, for V9.	44-TF995A/1
253		Retainer, for V9.	45-TF995A/1
254	V10	EF95, Pentode.	101-TM4826
255		Holder, for V10.	98-TM4826
256		Retainer, for V10.	97-TM4826
257	V11	5Z4G, F.W. Rectifier.	16-TM4299
258		Holder, for V11.	15-TM4299
259		Retainer, for V11.	17-TM4299
260	V12	EF95, Pentode.	101-TM4826
261		Holder, for V12.	98-TM4826
262		Retainer, for V12.	97-TM4826
263	V13	D77, Double Diode.	46-TF995A/1
264		Holder, for V13.	44-TF995A/1
265		Retainer, for V13.	45-TF995A/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		CRYSTALS	
266	X1	Quartz Oscillator Crystal, 333.33 kc/s	102-TM4826
267		Holder, for X1.	98-TM4826
268		Retainer, for X1.	99-TM4826
269	X2	CS2A, Silicon Rectifier.	40-TM4297
270		Retaining Contact, for X2.	TD20400/7
		LAMP	
271	PL1	Pilot Lamp, 6.5 V, 0.3 A, M.E.S.	43-TF995A/1
		Pilot Lamp Holder, with Red Lens.	42-TF995A/1
		METER	
272	M1	0-100 μA, 500 Ω Nominal, Moving Coil, including clamping brackets.	TM3970/30

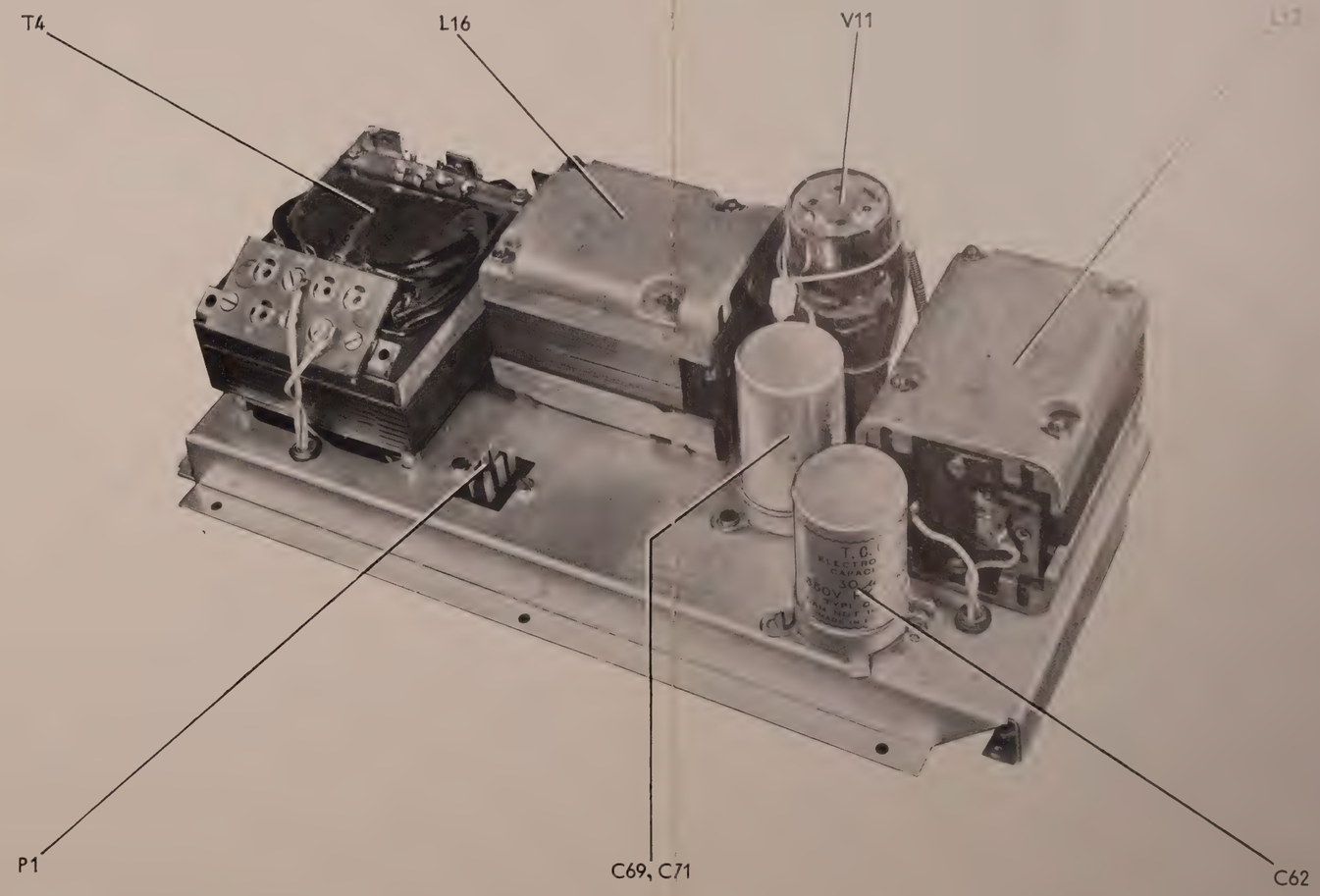
SOS Item No.	Circuit Ref.	Description	Works Ref.
		PLUGS, SOCKETS, and CONNECTING LEADS	
273	P1	Plug, 6-way.	18-TM4299
274	SK1	Socket, 6-way.	55-TF995A/1
275		Mains Lead comprising 6-ft, 3-core Flexible Cable and 3-pin plug complete with Plastic Entry Sleeve.	TM2560AQ
276		R.F. Output Plug, coaxial, free.	30-TM4298
277		R.F. Output Cable, coaxial, 4 ft 6 in.	38-TM4298
278	J1	CRYSTAL CHECK Jack Socket, including Jack Plug.	54-TF995A/1
279		Bush, for Item 278.	TA19742
280		R.F. Socket, coaxial, fixed.	7-TM4736 7-TM4308
		KNOBS, DRIVES, and DIALS	
281		Knob, for TUNE control.	TB3901/A1
282		Incremental Dial. Calibrated.	TC20320/4
283		Set of three Special Screws for fixing Item 281 to Item 282.	TA4014
284		Cursor, for Incremental Dial.	TA20308
285		FREQUENCY DIAL. Uncalibrated.	TC20310/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		KNOBS, DRIVES, and DIALS (continued)	
286		Dial Escutcheon Mounting Ring.	TD20670/2
287		Dial Escutcheon (Chromium Plated), with Rubber Tubing Gasket, to fit over Item 286.	TD20670/1 8-TM4357
288		Window, including Movable Cursor Assembly, to fit in Item 287.	TC20735/2 TD20670/3 TA20726 TB6775/300 6-TM4357
289		Nylon Drive Cord.	12-TM4826
290		Knob, for MOD SELECTOR switch, S1.	39-TF995A/1
291		Knob, for RANGE MC/S switch, S2.	39-TF995A/1
292		Knob, for DEVIATION-NORMAL/HIGH switch, S5.	39-TF995A/1
293		Knob, for DEVIATION RANGE switch, S6.	39-TF995A/1
294		Knob, for OUTPUT VOLTAGE attenuator.	37-TF995A/1
295		Knob, for MULTIPLY BY attenuator.	37-TF995A/1
296		Knob, for SET CARRIER control, R44.	38-TF995A/1
297		Knob, for SET MOD control, R25.	38-TF995A/1

SOS Item No.	Circuit Ref.	Description	Works Ref.
		MISCELLANEOUS	
298		Cover Plate, for R.F. Output Cable exit, in Right-Hand Handle Recess.	TA19721
299		Grommet, to fit in Item 298.	TA6515/1
300		Cable Saddle, to secure Item 277 to Item 298.	29-TF995A/1
301		Front Panel.	TD22009
302		Set of Eight Screws, complete with Black Fibre Washers for fixing Front Panel to Case.	30-TF995A/1 TB6775/183
303		Terminal, EXT MOD.	41-TF995A/1
304		Terminal, SYNC.	41-TF995A/1
305		Terminal, EARTH.	41-TF995A/1
306		Case Assembly complete with Handles, Feet, and Mains-Lead Grommet.	TM4310 TB18258 TA11420 98-TF995A/1
306a		Handle Escutcheon. Two included in Item 306.	TB18258
306b		Case Foot. Four included in Item 306.	TA11420
306c		Grommet, to fit Mains Lead hole in Case. Included in Item 306.	98-TF995A/1
307		20-dB Step Attenuator Assembly; includes Items 70 to 81 inclusive, 187, 188, 212 to 215 inclusive, 269 and 270.	TM4297
308		2-dB Step Attenuator Assembly; includes Items 82 to 98 inclusive.	TM4298

SOS Item No.	Circuit Ref.	Description	Works Ref.
		MISCELLANEOUS (continued)	
309		20-dB ATTENUATOR PAD; includes Items 99 to 101 inclusive, and Item 280.	TM4736
310		52- and 75-ohm TERMINATING UNIT; includes Items 102 to 104 inclusive, and Item 280.	TM4308
311		R.F. Unit Screening Cover.	TD20318 264-TM4826
312		Contact Spring for earthing R.F. Unit Screening Cover.	TC-20311/3E
313		Set of three Hexagonal Wrenches for Socket Set Screws, sizes 2, 4, and 6BA; complete in linen bag.	10A-TP9954/1
314		Operating and Maintenance Handbook.	TP9954/1

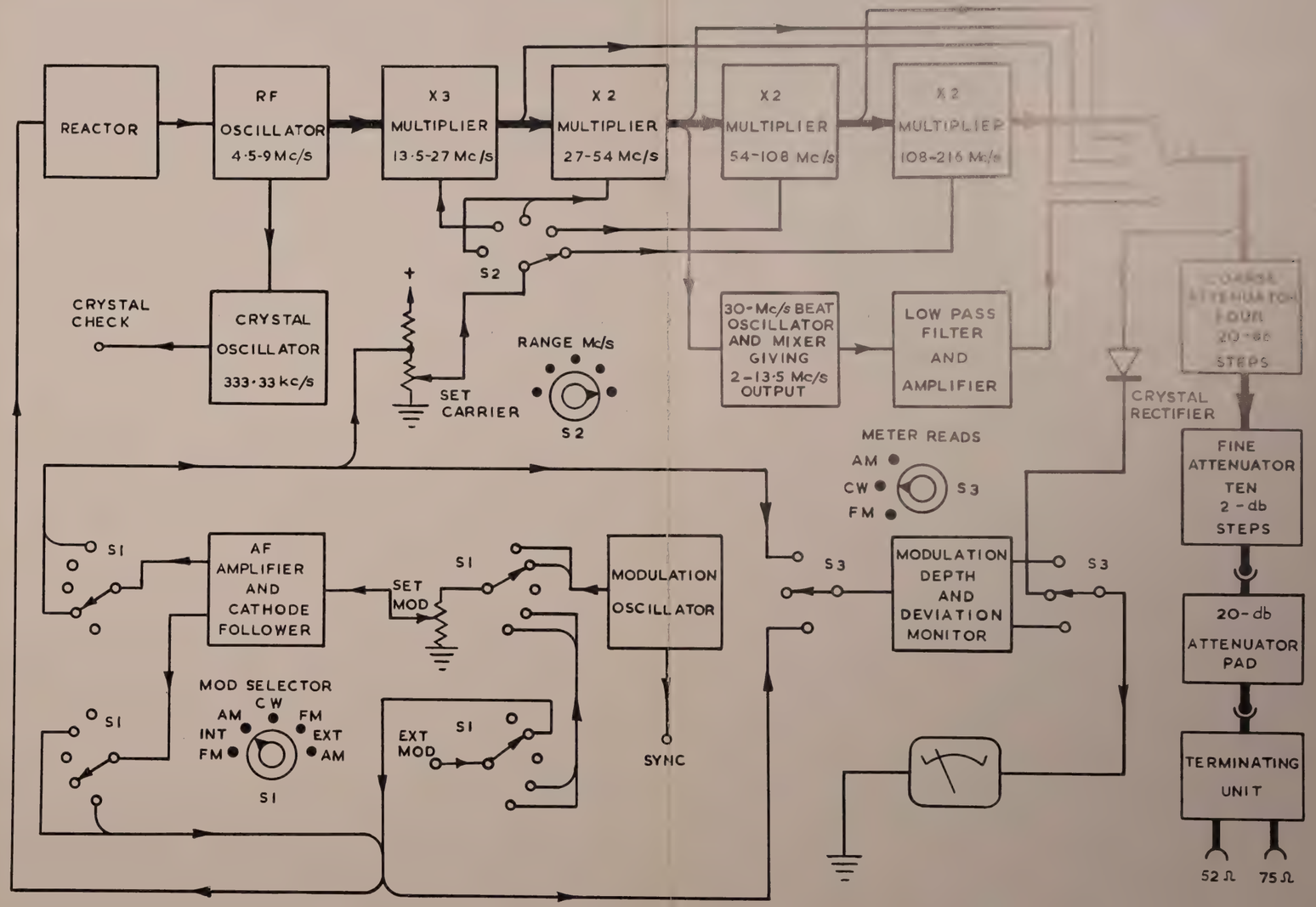
POWER UNIT



POWER UNIT

MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		MP 995A/1-8	

BLOCK SCHEMATIC DIAGRAM



BLOCK SCHEMATIC DIAGRAM

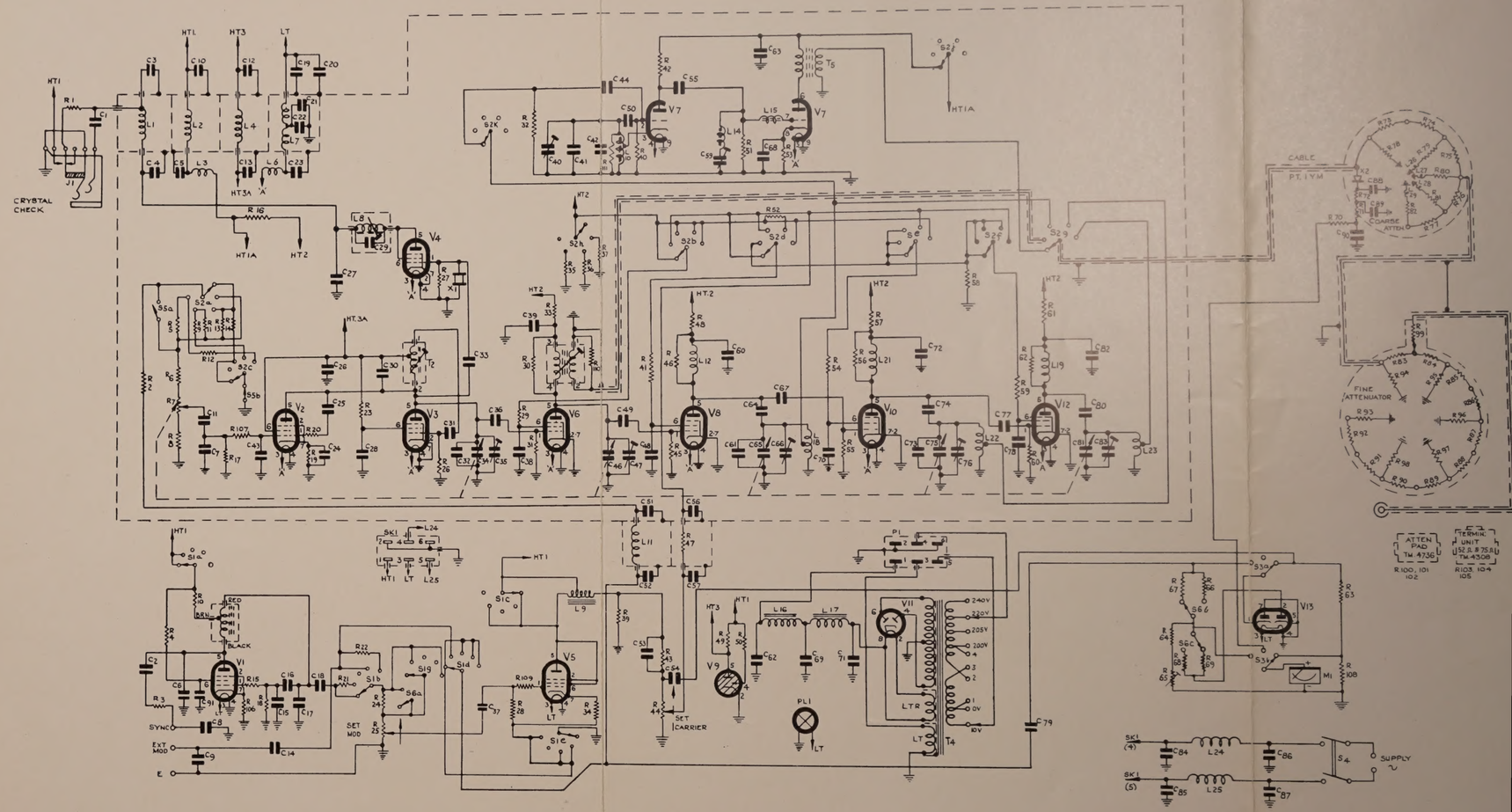
MARCONI INSTRUMENTS LIMITED							
DRN	W.R.C.	DATE	23.11.54	CHKD	W.R.C.	ISSUE	1
STOCK LIST		TF 995A/1		DRG No.		TBX 23556	

CIRCUIT DIAGRAM

AMENDMENT
TO
TDX 23080 ISSUE 16

1. The tapped inductor connected to the anode of V1 is T1.
2. The r.f. transformer with its primary winding between the anode of V6 and the junction of C39 and R33 is T3.
3. The anode connection of V7 (L.H. section) is pin 1.

MARCONI INSTRUMENTS LIMITED							
DRN	P.R.W.	DATE	3.11.54	CHKD	A.H.	ISSUE	16
STOCK LIST		TF 995A/1		DRG No.		TDX 23080	



CIRCUIT DIAGRAM

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
1·0	1·0	**0**	1·0	1·0
·9886	·9772	**·1**	1·012	1·023
·9772	·9550	**·2**	1·023	1·047
·9661	·9333	**·3**	1·035	1·072
·9550	·9120	**·4**	1·047	1·096
·9441	·8913	**·5**	1·059	1·122
·9333	·8710	**·6**	1·072	1·148
·9226	·8511	**·7**	1·084	1·175
·9120	·8318	**·8**	1·096	1·202
·9016	·8128	**·9**	1·109	1·230
·8913	·7943	**1·0**	1·122	1·259
·8710	·7586	**1·2**	1·148	1·318
·8511	·7244	**1·4**	1·175	1·380
·8318	·6918	**1·6**	1·202	1·445
·8128	·6607	**1·8**	1·230	1·514
·7943	·6310	**2·0**	1·259	1·585
·7762	·6026	**2·2**	1·288	1·660
·7586	·5754	**2·4**	1·318	1·738
·7413	·5495	**2·6**	1·349	1·820
·7244	·5248	**2·8**	1·380	1·905
·7079	·5012	**3·0**	1·413	1·995
·6683	·4467	**3·5**	1·496	2·239
·6310	·3981	**4·0**	1·585	2·512
·5957	·3548	**4·5**	1·679	2·818
·5623	·3162	**5·0**	1·778	3·162
·5309	·2818	**5·5**	1·884	3·548
·5012	·2512	**6**	1·995	3·981
·4467	·1995	**7**	2·239	5·012
·3981	·1585	**8**	2·512	6·310
·3548	·1259	**9**	2·818	7·943
·3162	·1000	**10**	3·162	10·000
·2818	·07943	**11**	3·548	12·59
·2512	·06310	**12**	3·981	15·85
·2239	·05012	**13**	4·467	19·95
·1995	·03981	**14**	5·012	25·12
·1778	·03162	**15**	5·623	31·62

MP MASTER
MA30916